



INSTITUTE FOR DEFENSE ANALYSES

Climate Change Effects: Issues for International and US National Security

Christine Youngblut

July 2009

Approved for public release;
unlimited distribution.

IDA Document D-3906
Log: H 09-001103



The Institute for Defense Analyses is a non-profit corporation that operates three federally funded research and development centers to provide objective analyses of national security issues, particularly those requiring scientific and technical expertise, and conduct related research on other national challenges.

About this Publication

This work was conducted under IDA's independent research program (C2222). The views, opinions, and findings should not be construed as representing the official position of the Department of Defense.

Copyright Notice

© 2009, 2010 Institute for Defense Analyses, 4850 Mark Center Drive, Alexandria, Virginia 22311-1882 • (703) 845-2000.

INSTITUTE FOR DEFENSE ANALYSES

IDA Document D-3906

**Climate Change Effects: Issues for
International and US National Security**

Christine Youngblut

PREFACE

The Institute for Defense Analyses (IDA) prepared this document in partial fulfillment of the Central Research Program task titled "Climate Mitigation and Adaptation, An Integrated IDA Approach." The research was conducted during the period March 2009-June 2009. The task was to update IDA's staff members understanding about the security implications that are already arising as a consequence of the effects of climate change. It provides a framework for discussions identifying how climate change effects interact with the areas of responsibility of IDA's sponsor base.

The author thanks the reviewers: Dr. Joan Cartier, Mr. Jason Dechant, Mr. Brendan Farrar-Foley, Dr. Forrest Frank, Dr. James Heagy, Dr. Terry Heuring, Mr. Mart Lidy, Dr. Jamie Link, Dr. Margaret Myers and Mr. Zachary Rabold of IDA for their valuable comments. Thanks also to Mr. Mart Lidy for providing Appendix B.

The author also thanks those who attended a staff lunchtime discussion for their additional insights: Mr. Thomas Barnett, Dr. David Bray, Dr. Joseph Buontempo, Dr. Brian Cohen, Ms. Marilee Cunningham, Dr. Gregory Davis, Dr. Dennis DeRiggi, Dr. Tony Fainberg, Mr. Keith Green, Mr. Frederick Hartman, Mr. Edward Kenschaft, Dr. Gregory Larsen, Dr. Jamie Link, Mr. Frank Mahncke, Mr. Philip Meade, Mr. Michael Nash, Ms. Vanessa Pena, Mr. Ronald Rolph, Dr. Jocelyn Seng, Mr. Mark Tillman, Dr. Richard Van Atta, Mr. Ryan Wagner, Gen. Larry Welch (Ret.), and Dr. Stanley Weeks.

Contents

1. Introduction	1
1.1 Purpose	1
1.2 Structure of Paper	1
1.3 Sources of Information	1
2. Broad Findings for Security	3
3. Issues for the International Community	7
4. Issues and Concerns at the U.S National Level	13
4.1 Changes in the Arctic	13
4.2 Other International Concerns	14
4.3 Domestic Impacts	16
4.4 Strategic Initiatives Needed	16
4.5 Coordination, Both National and International	19
5. Issues for Department of Defense	21
5.1 In the Arctic	21
5.2 Impact on Non-Arctic Roles and Missions	22
5.3 New Partnerships	23
5.4 Stress on DoD Capacity and Capabilities	23
5.5 DoD Planning	24
6. Key Issues Going Forward	27
Acronyms and Abbreviations	31
References	33
Appendix A: Chronology of Climate Change and Security Events	41
Appendix B: Recommendations for DoD – Response to Climate Change Amplified Disasters	49
B.1. DoD in Steady State Operations	49
B.2. DoD in Contingency Operations	49

Table of Figures

Figure 1. Consensus Findings about Climate Change Security Threats	3
Figure 2. FY2008 National Defense Authorization Act Coverage of Climate Change (NDAA 2008).....	4
Figure 3. Climate in Peril, Asia (taken from UNEP 2009).....	8
Figure 4. Climate in Peril, Africa (taken from UNEP 2009)	9
Figure 4. Examples of Security Implications of Primary Climate Change Impacts	9
Figure 5. Examples of Security Implications of Secondary Impacts.....	10
Figure 6. Examples of Security Implications of Tertiary Impacts.....	10
Figure 7. Climate Change and U.S. National Security (Lynch 2009)	13
Figure 8. Climate Change Questions for the QDR (Goodman 2009).....	21

List of Tables

Table B- 1. Major Sectors of Military and Civil Defense Assets	50
Table B- 2. Minimum Standards for Water – Humans.....	51
Table B- 3. MCDA Service Modules – Water Treatment and Purification.....	52

1. Introduction

1.1 Purpose

Prior to 2006, the security implications of climate change effects received only occasional attention. The level of interest rose exponentially over the following eighteen months. Now climate change is widely recognized as a threat that is tightly interconnected with other 21st century challenges such as energy security, terrorism, proliferation of weapons of mass destruction, and organized crime. This paper provides an overview of current views on how the consequences of warming temperatures, rising sea levels, disturbances in precipitation patterns, and increases in extreme weather events might impact global stability. The purpose is to raise awareness of the full scope of climate-related security concerns. It also identifies opportunities to strengthen the U.S. in preparing to respond to the changes in security tensions that could accompany climate impacts.

This is one in a series of papers looking at climate change issues. Others are expected to address climate change adaptation, human health concerns, and potential impacts on critical infrastructure. An additional paper summarizing major issues in the development and application of climate change science is already available. By identifying the key issues, each paper identifies potential opportunities for strengthening the U.S. response to climate change.

1.2 Structure of Paper

The next section of this paper summarizes consensus views about the types of security threats that are expected. The three sections following present issues at successive levels: first, at the international community level, then the U.S. national level, and lastly, for the Department of Defense (DoD). Some topics repeat across these levels, reflecting the different concerns that arise at each level. The final section consolidates key issues to identify those that are critical for near-term responses.

Two appendices provide supporting information. The first offers a chronology of major events marking the growing awareness of climate change and its security implications, evidenced by policy statements, congressional hearings, and release of major studies. Links provide access to additional information for those who wish further detail. The second appendix illustrates some of the types of needed actions, in terms of recommendations specifically geared towards DoD's response to climate-induced humanitarian assistance and disaster relief.

1.3 Sources of Information

The information used in this paper was obtained from major studies that have examined climate change effects and security, conference and workshop proceedings and reports, testimonies given by distinguished experts before Congress, statements and resolutions by authoritative groups, U.S. national directives and strategic-level documents, and notable reports on specific climate change impacts or especially vulnerable regions. Additional inputs were gained from Institute for Defense Analyses (IDA) staff members who brought the breadth of IDA's expertise to bear in identifying additional issues and stakeholder needs.

2. Broad Findings for Security

The Chairman, National Intelligence Council makes the following key observations:¹

"We judge global climate change will have wide-ranging implications for U.S. national security interests over the next 20 years. Although the U.S. will be less affected and is better equipped than most nations to deal with climate change, and may even see a benefit owing to increases in agriculture productivity, infrastructure repair and replacement will be costly. We judge that the most significant impact for the U.S. will be indirect and result from climate-driven effects on many other countries and their potential to seriously affect U.S. national security interests. We assess that climate change alone is unlikely to trigger state failure in any state out to 2030, but the impacts will worsen existing problems—such as poverty, social tensions, environmental degradation, ineffectual leadership, and weak political institutions. Climate change could threaten domestic stability in some states, potentially contributing to intra- or, less likely, interstate conflict, particularly over access to increasingly scarce water resources" (Fingar 2008, pg. 4-5).

These views are consistent with those of other experts and groups who have examined the implications of climate change for international and U.S. national security. Although the purpose, scope, and intended audience of the various works differ, there is a strong consensus about the types of security threats that climate change will, and will not, pose. These views are shown in **Figure 1**.

- Climate change impacts are expected to intensify crisis situations and exacerbate existing conflicts, but are not expected to be a direct cause of conflict. State collapse and destabilizing internal conflicts are more likely outcomes of climate change than interstate war. Even so, climate change will add to tensions even in stable world regions.
- There is greater potential for failed states and political instability. Climate change acts as a threat multiplier for instability in some of the most volatile regions of the world. It threatens to undermine governments' ability to ensure security and stability. Economic and environmental conditions in already fragile areas will further erode as food production declines and clean water becomes increasingly scarce and large populations move in search of resources.
- Climate change provides new opportunities for cooperation and tension reduction. The need to address critical resource shortages and climate shocks can provide a common basis for constructive engagement between previously opposed groups.
- Developing countries will suffer the most. Coupled with rapid population growth, climate change can undermine the carrying capacity of many developing countries. Water and food shortages, and land loss will stress already marginal living standards. Economic instability will leave communities highly vulnerable, both to sudden environmental shocks and more gradual erosion of their livelihood security.
- Mass migrations are expected both inter- and intra-state. Tens and hundreds of millions are expected to become environmental refugees over the next few decades. Large population movements constitute a potential threat to international security, particularly if there are pre-existing ethnic and social tensions. When they occur over short periods, they can also cause political stress, usually accompanied by economic and social upheaval.
- Many risks can propagate beyond the affected region. Migration, for example, in response to reduced access to key resources can place additional stress on perhaps already strained resources in receiving areas, increasing vulnerability in these areas.
- The potential for crisis and the number of people affected may both reach unprecedented levels worldwide. The potential scale and scope of humanitarian crises are expected to overwhelm existing support programs and agencies.

CONSENSUS findings

Figure 1. Consensus Findings about Climate Change Security Threats

¹ From Dr. Thomas Fingar's testimony based on the National Intelligence Assessment (NIA) on the *National Security Implications of Global Change to 2030*, given to the open Joint Hearing of the House Permanent Select Committee on Intelligence, Subcommittee on Intelligence Community Management and the House Select Committee on Energy Independence and Global Warming on "[National Security Implications of Climate Change](#)," June 23-25, 2008.

Overall, the primary climate-related security threat is an increase in instability in weak nation states that are already vulnerable to multiple stresses.

An increasing number of countries regard climate change as a security threat. Largely at the urging of the United Kingdom (U.K.), the United Nations (UN) Security Council held its first [debate on the impact of climate change on peace and security](#) in April 2007. The following March, the National Security Strategy of the U.K. (2008) stated “*Climate change is potentially the greatest challenge to global stability and security, and therefore to national security.*” That same month, the High Representative and Commission identified climate change as a “*threat multiplier*” in a report to the European Council ([EC 2008](#)). In December 2008, the implementation report on the European Security Strategy identified climate change as a “*global challenge and key threat*” ([EU 2008a](#)). Also in December 2008, the UN General Assembly (2008) ‘invited’ the Security Council to continue to consider and address, as appropriate, the threat posed by climate change. The same month, the Prime Minister of Australia identified global warming as a formal threat to that country’s national security ([Rudd 2008](#)).

In the U.S., the [FY 2008 National Defense Authorization Act \(NDAA\)](#) released in February 2008 established a legal requirement for climate change to be explicitly addressed in the next National Security Strategy, National Defense Strategy, and Quadrennial Defense Review, see Figure 2. The previously mentioned NIA on climate change was released by the National Intelligence Council (NIC) in the following April.

SEC. 951. DEPARTMENT OF DEFENSE CONSIDERATION OF EFFECT OF CLIMATE CHANGE ON DEPARTMENT FACILITIES, CAPABILITIES, AND MISSIONS.

- (a) Consideration of Climate Change Effect- Section 118 of title 10, United States Code, is amended by adding at the end the following new subsection:
 - `(g) Consideration of Effect of Climate Change on Department Facilities, Capabilities, and Missions- (1) The first national security strategy and national defense strategy prepared after the date of the enactment of the National Defense Authorization Act for Fiscal Year 2008 shall include guidance for military planners--
 - `(A) to assess the risks of projected climate change to current and future missions of the armed forces;
 - `(B) to update defense plans based on these assessments, including working with allies and partners to incorporate climate mitigation strategies, capacity building, and relevant research and development; and
 - `(C) to develop the capabilities needed to reduce future impacts.
 - `(2) The first quadrennial defense review prepared after the date of the enactment of the National Defense Authorization Act for Fiscal Year 2008 shall also examine the capabilities of the armed forces to respond to the consequences of climate change, in particular, preparedness for natural disasters from extreme weather events and other missions the armed forces may be asked to support inside the United States and overseas.
 - `(3) For planning purposes to comply with the requirements of this subsection, the Secretary of Defense shall use--
 - `(A) the mid-range projections of the fourth assessment report of the Intergovernmental Panel on Climate Change;
 - `(B) subsequent mid-range consensus climate projections if more recent information is available when the next national security strategy, national defense strategy, or quadrennial defense review, as the case may be, is conducted; and
 - `(C) findings of appropriate and available estimations or studies of the anticipated strategic, social, political, and economic effects of global climate change and the implications of such effects on the national security of the United States.

Figure 2. FY2008 National Defense Authorization Act Coverage of Climate Change ([NDAA 2008](#))

In January 2009, President Obama established the White House Office of Energy and Climate Change Policy. This office’s Director, Carol Browner, holds the new position of Assistant to the President for Energy and Climate Change. In May, the President created a Global Engagement Directorate within the National Security Council (NSC) that will reportedly “*help pull together what until now has been an incoherent response to climate change and energy security*”.^{2,3} The NSC itself is preparing a new National Security

² Reported in http://www.insidedefense.com/secure/display.asp?docnum=682009_june8b&f.

Directive that will address both climate and energy issues.⁴ No details are yet available about these new organizations or activities.

Another noticeable change over the past year has been **an increasing pessimism that the international community will achieve effective mitigation policies in time to prevent major climate change impacts**. Earlier work was unanimous in stressing urgency in mitigating further climate change. This urgency is driven by the need to keep rising temperatures below a “tipping point” that might trigger abrupt and, possibly, catastrophic climate responses and by concern that failure to take difficult actions that slow down rising temperatures within the next 10–15 years will necessitate more draconian measures later on. Given that recent data indicate that an increase of 4°C may occur by the end of the 21st century, there is **more call for planning for extreme and abrupt climate changes**.⁵ The security implications of climate change are proportional both to the speed and extent of change ([Johnson 2007](#)). So these data also **raise questions about the validity of impact assessments conducted to this point**, the great majority of which assumed a significantly slower rate of climate change than is now expected.

Two important climate change characteristics provide further context for the issues summarized in the following sections:

- Unlike most conventional security threats characterized by the activities of single entities acting in specific ways, climate change has the potential to result in **multiple chronic conditions, occurring globally within the same time frame** ([USJFCOM 2007](#)).
- Climate changes **do not follow linear trends**; preparations should anticipate greater variability, not gradual changes ([Dumaine 2009](#)).

The full impacts of climate change cannot be appreciated in isolation of other threats and global trends. Forced migrations caused by climate-accelerated degradation of agricultural lands in one region, for example, are likely to increase pressure on the infrastructure and services in developing regions, spreading the adverse impacts and potentially undermining economic growth in receiving regions. Consequent water and food shortages increase a population’s susceptibility to illness at a time when climate induced increases in infectious diseases are expected in many vulnerable regions. More prevalent illness in a population can also negatively impact economic conditions and development. The population increases projected for most developing countries in the coming decades will exacerbate these effects.⁶

Climate change can trigger unanticipated cascading effects even in developed countries. Heat waves in both Europe and the U.S., for example, have forced the shutdown of nuclear power plants when demand was highest ([Dumaine 2009](#)).

³ Section 3 provides some examples of the interdependences between climate change and energy security.

⁴ *Ibid.*

⁵ The [Climate Congress: Global Risks, Challenges and Decisions](#) found that temperature increases are expected to rise above those projected in the Intergovernmental Panel on Climate Change worst-case scenario (A1F1): an increase of 4.0°C (likely range is 2.4°C to 6.4°C) ([Richardson et al. 2009](#)).

⁶ Between 2008 and 2050, virtually all population growth will take place in the Least Developed Countries, where the population will grow from 5.5 billion in 2008 to 8.1 billion in 2050 ([PRB 2008](#)).

3. Issues for the International Community

The climate has changed more rapidly in the Arctic than elsewhere and has arguably seen more attention.⁷ We start by reviewing how various governments and intergovernmental organizations (IGOs) are responding to these changes. The remainder of this section exemplifies security concerns for the rest of the world and briefly touches on the connections between climate change and energy security.

Implications of changes in the Arctic – Major reductions in Arctic sea ice have raised issues over (1) anticipated highly strategic and potentially valuable trade routes and (2) control of previously inaccessible petroleum reserves ([Burd 2006](#); [Butts 2007](#); [Busby 2007](#); [IISD 2007](#); [NDU 2008](#)). These issues concern more than the five Arctic coastal nations. China, for example, is dependent on foreign trade and 46 percent of its GDP is shipping dependent; a Northwest Passage brings China 4000 nautical miles closer to the European Union (EU) and the east coast of North America ([Spears 2009](#)). Overall, the significant distance and fuel savings offered by the new shipping routes could produce a seismic shift in world trade patterns and the nature and form of commercial shipping. Non-Arctic countries are understandably concerned that governance of the exploitation of Arctic resources takes account of the interests of all countries ([German Marshall Fund 2009](#)). China, for example, is hungry for oil and gas resources to fuel its growing industry ([Spears 2009](#)).

There is no specific treaty regime for the Arctic. No country or group of countries has sovereignty over the North Pole or the Arctic Ocean around it. The [Arctic Council](#)⁸ is the high-level intergovernmental forum that acts as the primary governing body, but an Arctic security policy is explicitly outside the council's role. In its recent [Tromsø Declaration](#), the Arctic Council ([2009a](#)) identified climate change as "one of the greatest challenges facing the Arctic" and stated its intention to enhance its circumpolar and global leadership on Arctic issues. But this declaration failed to specify how existing problems will be addressed; these problems include fragmentation in the legal framework; a lack of effective governance instruments; the absence of an overall policy-setting process; and gaps in participation, implementation and geographic scope ([EU 2008b](#)).

The [UN Convention on the Law of the Sea \(UNCLOS\)](#)⁹ applies to the Arctic but there are problems in its application. The jurisdictional status of some Arctic waters remains controversial, in particular with regard to internal waters and straits used (or potentially to be used) for international navigation ([Arctic Council 2009b](#)). The lack of clear principles for the delimitation between the adjacent or opposing Exclusive Economic Zones (EEZs) of the Arctic coastal states is another source of current and, potentially, future disputes. Perhaps the most important of the conflicting claims in economic and security terms is the Russian-Norwegian disagreement over the two countries' EEZs in the Barents Sea ([Holtsmark 2009](#)). There are additional issues surrounding claims to the continental shelves beyond the 200 nautical mile EEZs. UNCLOS does, however, provide a regime for the management and exploitation of mineral resources on the seabed and in the subsoil in areas outside any state's jurisdiction. In May 2008, the five Arctic Ocean coastal states¹⁰ adopted the [Ilulissat Declaration of the Arctic Ocean](#) stating that they remain committed to the legal framework in place ([Arctic States 2008](#)).

The EU Commission and the High Representative for the Common Foreign and Security Policy find that the altering geo-strategic dynamics of the Arctic have potential consequences for both international stability and European security interests. They have called for a more proactive role in the Arctic and a standalone EU Arctic policy to (1) protect and preserve the Arctic in union with its population, (2) promote sustainable use of resources, and (3) contribute to enhanced Arctic multilateral governance ([EU 2008b](#)).

⁷ The [International Polar Year 2007–2008](#) focused international attention on scientific questions concerning the Arctic and Antarctic. This was the fourth polar year, following those in 1882–3, 1932–3, and 1957–8. It was organized through the International Council for Science and the World Meteorological Organization.

⁸ The Arctic Council provides a mechanism to address common concerns and challenges faced by the Arctic Governments and the Indigenous Peoples of the Arctic. The members are Canada, Denmark (including the Faroe Islands and Greenland), Finland, Iceland, Norway, the Russian Federation, Sweden, and the U.S.

⁹ The U.S. has not joined the UNCLOS.

¹⁰ Canada, Denmark, Norway, the Russian Federation and the U.S.

Given the long histories and existing relationships among the Arctic nations, it is extremely unlikely that the various points of contention will lead to armed conflict. It is doubtful, however, that the Arctic will continue as a virtual non-militarized zone now that the Russian Federation has started to arm its icebreakers (NDU 2008). Petroleum reserves and other natural resources in the Russian European High North and in Northern Siberia already provide up to 20 percent of its GDP. So it is not surprising that Russia views Arctic hydrocarbons as vital economic interests and intends to remain a strong commercial and military presence (German Marshall Fund 2009). The Russian policy for the Arctic, released by the Russian Security Council in March 2009, is for the Arctic to become Russia's top strategic resource base by 2020 ([Foreign Policy Association 2009](#)).¹¹ This council has committed to developing a new Arctic Group of Forces to carry out this policy. Whether Russia maintains the will and ability to bring these plans to practical fruition remains uncertain (Holtsmark 2009).

Implications elsewhere – It is widely acknowledged that the developing world will suffer the worst from climate change, primarily because these countries have little ability to absorb further stresses and have a reduced adaptation capacity. These countries may face multiple concurrent additional stresses, as demonstrated in Figure 3 and Figure 4. The geopolitical implications of two direct climate change impacts are given as illustrative examples in Figure 5 and the next two figures give examples of security issues at the secondary and tertiary levels.

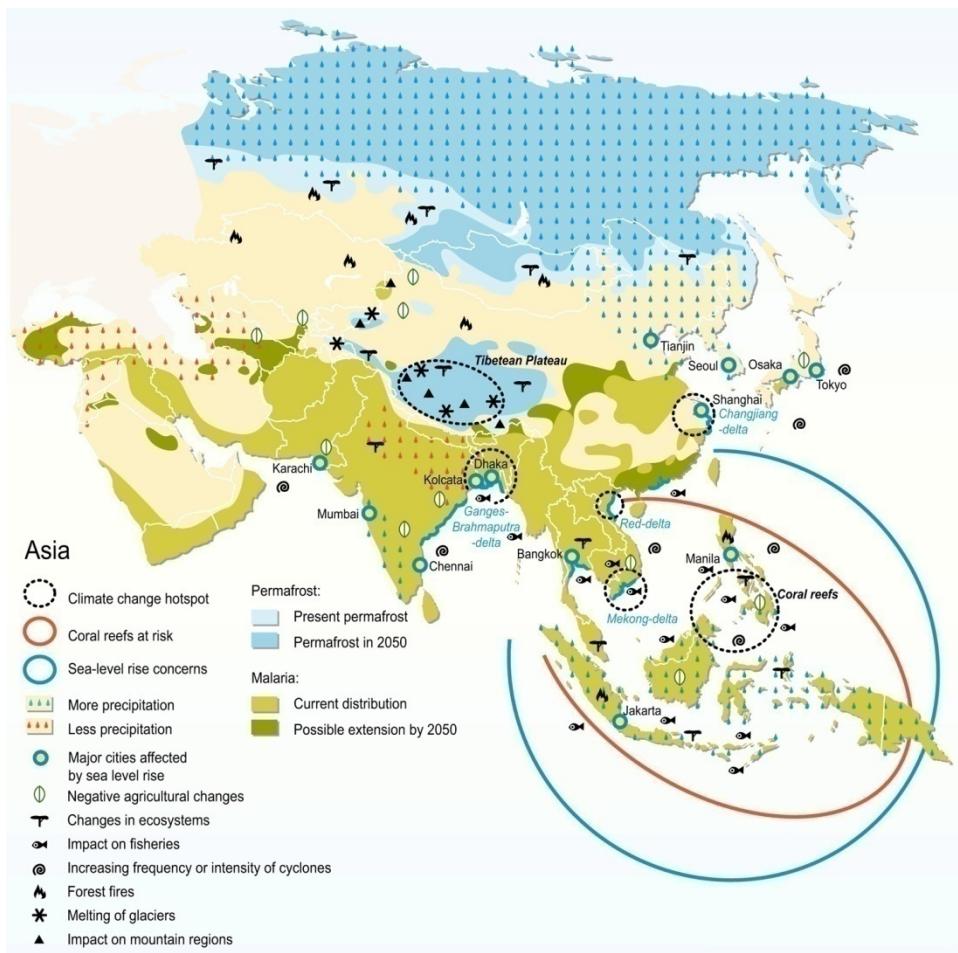


Figure 3. Climate in Peril, Asia (taken from [UNEP 2009](#))¹²

¹¹ The original policy document is available in Russian at: <http://www.scrf.gov.ru/news/421.html>.

¹² In this figure, the increase in the extent of permafrost reflects the projected retreat of glacial ice.

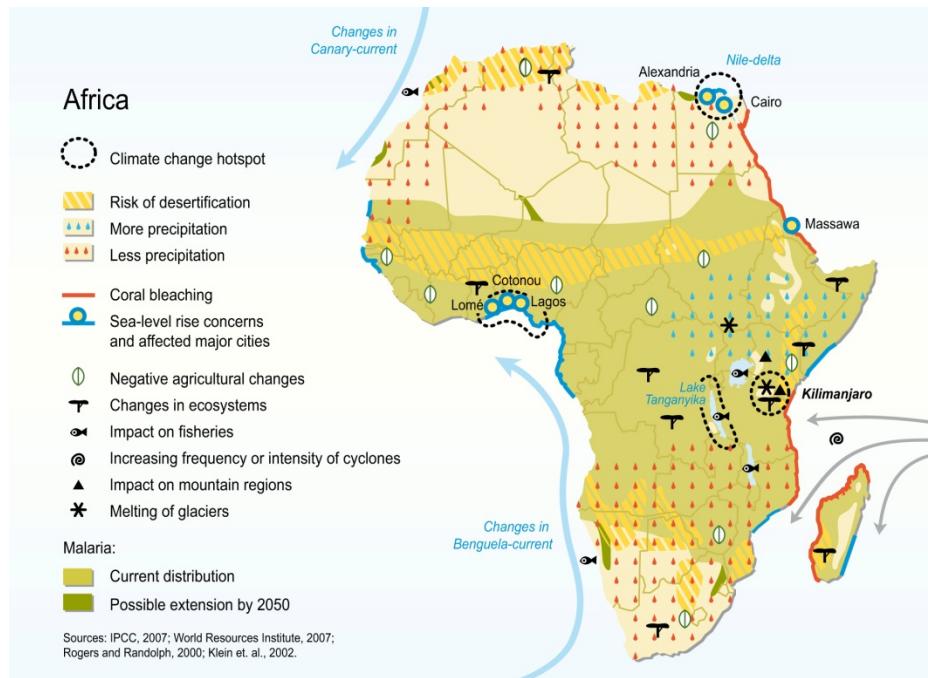


Figure 4. Climate in Peril, Africa (taken from [UNEP 2009](#))

Major changes in landmass – Changes ranging from rising sea levels to retreating glaciers will raise issues over land and maritime borders and other territorial rights during this century. The submersion of even small atolls, rocks, and low-lying islands, for example, is critically important. These are commonly used to claim vast tracts of ocean that would otherwise fall outside the EEZs of contiguous states and be open to foreign exploration and exploitation. Existing rules of international law as regards the resolution of territorial and border disputes need to be revisited in anticipation of projected changes ([Lowry Institute 2006](#)).

In Asia, for example, rising sea levels could complicate the resolution of disputed sovereignty claims in the Spratly Islands and Beijing's challenge of the island status of Okinotorishima ([Dupont 2008](#)).

Extreme weather events and rising sea level – Sea level rise and increases in the frequency and intensity of storms pose a serious threat to coastal regions and their economic prospects ([CNA 2007; EC 2008](#)). Additionally, most of the economically important major rivers and river deltas in the world—the Niger, the Mekong, the Yangtze, the Ganges, the Nile, the Rhine, and the Mississippi—are densely populated along their banks. Rising sea levels and increases in storm surges will contaminate ground water, inundate river deltas and valleys, and destroy croplands (CNA 2007). The east coasts of China and India, the Caribbean region, and Central America will be particularly impacted (EC 2008). Saltwater intrusion is already contaminating underground water sources in Israel, Thailand, and small island states such as those in the Pacific, Indian Ocean, and South China Sea ([Herman & Treverton 2009; Mabey 2008](#)). In developing countries and small island states the resulting migrations may generate considerable tensions.

Figure 5. Examples of Security Implications of Primary Climate Change Impacts

Resource scarcity – Management of chronic food and water shortages will assume increasing importance for a growing number of countries ([Blair 2009](#)). Tensions could increase within and between states that experience shrinking water supplies and countries with an abundant water supply could seek to exploit it for diplomatic advantage ([CSIS & CNAS 2007](#)). Water and water-related issues (such as drought, famine, flooding, and disease) are major threats to regional security throughout the world ([CNA 2007](#)). A drop in agricultural productivity will lead to, or worsen, food insecurity in least developed countries and an unsustainable increase in food prices across the board with unanticipated changes in the global trading regime ([Gleick 2006](#)). The overall effect is that climate change could fuel existing disputes over depleting resources, especially where access to those resources is politicized ([EC 2008](#)).

In India, for example, water scarcity resulting from glacial recession could impact conflict dynamics in Jammu and Kashmir, the India-China border, the Bangladesh ethnic invasion, and the Nepal civil war ([Pai 2008](#)). The Amu Darya-Syr Darya river basin is another area of concern because of tensions between upstream Kyrgyzstan and Tajikistan and downstream Kazakhstan and Turkmenistan ([Solana 2008](#)).

Human health – In addition to direct impacts such as heat waves, major concerns are significant spreading of conditions for vector-borne diseases, such as dengue fever and malaria, and food-borne diseases, such as salmonellosis. The decline in available fresh water in some regions will also have an impact on health. A health emergency involving large numbers of casualties and deaths from disease can quickly expand into a major regional or global security challenge that requires military support, ranging from distribution of vaccines to full-scale stability operations (CNA 2007). On a global scale, increases in the burden of disease will exert a drag on the global economy and perpetuate poverty within the least developed countries ([Price-Smith 2007](#)).

The World Health Organization estimates that 154,000 deaths annually are already attributable to the ancillary effects of increased temperatures, due mainly to malaria and malnutrition. This number could nearly double by 2020 ([Dupont 2008](#)).

Figure 6. Examples of Security Implications of Secondary Impacts

Migration and immigration – Climate change may force migrations of workers due to economic conditions, but the greatest concern will be movement of asylum seekers and refugees who, due to ecological devastation, become permanent settlers ([CNA 2007; Butts 2007](#)). Migration within a country can add to a nation's political stress, cause economic upheaval—positive and negative—and distract from other issues. Migration across borders raises the potential for political conflict as many receiving nations lack the resources or interest to host the migrants ([Fingar 2008](#)). When large distances are involved, it can shift demographics and create racial and religious tensions (CNA 2007). The ability to migrate is a function of both mobility and resources. The business and educated elite are the ones with the resources, so migrations are likely to further deprive developing countries of needed economic and intellectual capital ([Lennon 2007](#)). The lack of an accepted definition of 'environmental refugee' handicaps the international system from providing for migrants ([Brown 2007](#)).

Estimates of forced migration vary, but the most common is for 200 million migrants by 2050 (Brown 2007, CNA 2007). Examples of likely migrations include from the South Caucasus and Central Asia into Russia, which could dampen prospects for Sino-Russian cooperation ([Herman & Treverton 2009](#)). In China's Xinjiang province, a projected increase in rainfall is likely to attract an influx of Han migrants into the Muslim Uighur ancestral lands where a low-level insurgency is already festering ([Dupont 2008](#)).

Conditions favoring terrorism – In already-weakened states, climate change impacts will likely result in further instability, expanded ungoverned spaces, and increased extremism. These effects exacerbate underlying conditions that terrorist groups seek to exploit. ([Butts 2008; CNA 2007; Lennon 2007; USJFCOM 2007](#))

Violent extremists can use climate-exacerbated stresses to fuel existing causes. Osama Bin Laden has spoken several times on the inequities of climate change ([Mabey 2008](#)).

Figure 7. Examples of Security Implications of Tertiary Impacts

Development and security policy are proving largely unequal to the task of promoting stability in the world's approximately 30 fragile states and would be completely overwhelmed by the range of adverse consequences expected from continued climate change ([CSIS & CNAS 2007](#)). Any resulting escalation in patterns of social destabilization could permanently impair the world economy and cause a crisis of legitimacy for the international system as a whole ([Schubert et al. 2008](#)).

The UN system and other international organizations and governments need to integrate climate change concerns more fully into their security, natural disaster prevention, and humanitarian response activities ([Smith and Vivekananda 2007](#); [Woodrow Wilson 2004](#)). But the fact remains that IGOs are already pressed to the limit. Additionally, an increase in disasters and humanitarian crises will lead to immense pressure on the resources of donor countries, including the capacities for emergency relief operations ([EC 2008](#)). It is vital that attention focuses more strongly on disaster indicators, prediction, and preparedness (Woodrow Wilson 2004).

At its April [Summit meeting](#) in Strasbourg, NATO ([2009](#)) issued a [Declaration on Alliance Security](#) that calls for rewriting its Strategic Concept to reflect a global environment where the multilateral use of power is only a part of the solution to dealing with issues. The new strategy will promulgate the concept of networked security to harmonize international cooperation and reflect climate change, energy security, and cyber-attacks as new threats to NATO. It is too soon to predict how NATO might restructure itself to better meet these challenges.

Developed countries have a direct national security interest in helping developing countries and vulnerable populations to adapt to expected climate changes (Busby 2007). Under the concept of environmental security, such adaptation becomes a preventive security policy. Unfortunately, at this time the separation between ideas of development and sustainability means that rendering this support is perceived as maintaining an ill-understood balance between development aid and resources focused on adaptation. This view will be particularly detrimental should donor countries have difficulties in maintaining existing levels of international aid as they face increasing adaptation costs in their own countries; particularly in view of the current economic crisis. Some adaptations require specialized skills and equipment that are in limited supply. There will be hard decisions to make and there are no rubrics for guiding them.

Adaptation activities can themselves create tensions. China's Prime Minister, for example, recently stated that water security threatens the survival of the Chinese nation and the country is undertaking an ambitious water diversion scheme intended to bring over 40 billion cubic meters of water annually to China's water scarce regions.¹³ One part of this effort involves diverting the Yalong Tsangpo River just before it enters India. For India, which does not have a water sharing agreement with China, this project is a direct threat to lives and livelihoods of millions of people living downstream.

A failure, or perceived failure, of the developed nations to assist developing countries in managing adverse climate impacts may cause a further spike in north-south tensions (CSIS & CNAS 2007; Schubert et al. 2008). There is also the potential for a south - south rift as the Chinese and Indian share of global emissions rises (EC 2008). Some analysts are beginning to argue that immigration is a necessary element of global redistributive justice and an important response to climate change; further, that greenhouse gas emitters should take an allocation of climate migrants in proportion to their historical emissions ([Brown 2007](#)).

International policy work is centered on limiting future greenhouse gas emissions and this is clearly important. Given the degree of continued climate change that we are already committed to (from inertia in the climate system), adaptation deserves and requires an equivalent level of attention. Another issue impeding progress in this area is a concern that adaptation activities will redirect funding needed for development programs ([Smith and Vivekananda 2007](#)).

Energy security¹⁴ – Much of the world's currently accessed hydrocarbon resources are in regions vulnerable to climate impacts and which already face significant social economic and demographic challenges. An increase in instability in these regions has the potential to feed back into greater energy insecurity and greater competition for the resources ([EC 2008](#)). Climate changes in the Arctic raise a number of concerns. On the one hand, anticipated access to major new oil and gas fields has triggered intense interest in resolving long-standing uncertainties in the Arctic nations' territorial boundaries. On the other, high levels of coastal erosion and degrading permafrost pose threats to critical infrastructure that may impede ongoing and future operations.

¹³ Reported in <http://www.atimes.com/atimes/China/JL09Ad01.html>.

¹⁴ See [Powering America's Defense: Energy and the Risks to National Security](#) for a detailed discussion on energy security (CNA 2009).

International agreements to limit carbon emissions may generate new tensions as oil and gas demand declines and alternative energy sources become more valuable (CSIS & CNAS 2007; [IISD 2007](#)). The possible wider use of nuclear energy for power generation raises new concerns about proliferation (EC 2008; CSIS & CNAS 2007; [IISD 2007](#); [Purdy 2008](#)). Additionally, there is a global lack of the skilled resources needed to safely construct and operate the numbers of nuclear reactors currently being proposed (CSIS & CNAS 2007).

4. Issues and Concerns at the U.S National Level

Climate change poses a range of national and international security concerns for the U.S., as illustrated in Figure 8.

Similar to the previous section, this section starts by looking at security issues specific to the Arctic. It then considers those that may arise elsewhere in the world and in the homeland. Issues pertaining to a national strategic approach to climate-related security issues is next, focusing on the necessary planning activities and their associated information requirements. The final topic is the coordination, both national and international, that must underlie a strategic approach.



Figure 8. Climate Change and U.S. National Security (Lynch 2009)

4.1 Changes in the Arctic

In January, the White House (2009) issued [National Security Presidential Directive \(NSPD-66\)](#) and [Homeland Security Presidential Directive \(HSPD-25\)](#) to update U.S. Arctic policy. This update reflects the effects of climate change and increasing human activity in the Arctic region as well as (1) altered national policies on homeland security and defense, (2) the establishment and work of the Arctic Council, and (3) a growing awareness that the Arctic region is both fragile and rich in resources. The directives define U.S. national security interests in the Arctic, including such matters as missile defense and early warning; deployment of sea and air systems for strategic sealift, strategic deterrence, maritime presence, and maritime security operations; ensuring freedom of navigation and overflight; and preventing terrorist attacks and mitigating those criminal or hostile acts that could increase U.S. vulnerability to terrorism in the Arctic region.

The directives establish that freedom of the seas is a top U.S. national priority and state that existing maritime policies and authorities¹⁵ continue to apply. They identify U.S. accession to the UNCLOS as vital to supporting the maritime mobility of U.S. forces, as well as protecting and advancing other U.S. interests, and advise the Senate to support such accession. They recognize that working with the Arctic Council has accrued U.S. advantages in the past and affirm that the U.S. is open to updating the council's structure to meet new Arctic circumstances. Implementing government agencies and departments are also encouraged to consider new or enhanced international arrangements as appropriate to address issues arising from increased human Arctic activities. The updated policy addresses some of the issues surrounding outstanding boundary disputes with our neighbors and the need to map the extended U.S. continental shelf. But additional detailed guidance is needed in several areas, for example, the disparate roles of Department of the Interior (DOI), U.S. Coast Guard (USCG), Department of Transportation, and the Navy in Arctic missions ([NDU 2008](#)).

¹⁵ Specifically, Freedom of Navigation (PDD/NSC-32), the U.S. Policy on Protecting the Ocean Environment (PDD/NSC-36), [Maritime Security Policy \(NSPD-41/HSPD-13\)](#), and the [National Strategy for Maritime Security](#).

Although tasking for the Arctic region mentions the development of the capabilities and capacity needed to protect air, land, and sea borders, it is important to realize that infrastructure¹⁶, shipbuilding, and security improvements in the region will likely take a decade or more to mature (NDU 2008; [Paskal 2009](#)). In the interim, it is difficult to see how the U.S. can “assert a more active and influential national presence” with its current icebreaker fleet ([Burd 2006](#); [Navy 2007](#); NDU 2008). USCG formed a U.S. Polar Operations Working Group to review their Arctic policy. This group reported in February 2008 on identified problem areas and made a series of recommendations based on the level of effort that the U.S. would be able to commit to the Arctic.¹⁷ In summer 2008, USCG forward-deployed crew and equipment to Barrow in Alaska (320 miles north of the Arctic Circle) as a proof-of-concept for a strategic forward-operating location. Based on this activity, together with others at Prudhoe Bay, USCG is currently outlining its new Arctic responsibilities and mission essential equipment.¹⁸ At this time, USCG has two operational polar icebreakers, one of which is designed as a research vessel. A third has been in drydock since July 2006. Whether the \$30.3 million included in the FY2009 Homeland Security Department budget is sufficient to bring the 32-year old Polar Star back to operational status is uncertain. It would take 8–10 years and \$800 to \$925 million for a replacement polar icebreaker to enter service.¹⁹

4.2 Other International Concerns

The international system is already stressed by transition to a multi-power world, a global economic crisis, and increases in nonconventional security threats. Participants at a Sandia National Laboratory workshop noted that:

“It is possible to imagine the consequences of climate change either weakening or strengthening the position of the U.S. The results in either direction might not be greater international peace and stability. A weakened U.S. would be less capable of playing a stabilizing role—whether in international financial markets or in potential military conflicts...On the other hand, an even more lopsided distribution of power between the U.S. and the rest of the world might also carry risks. Not only non-state terrorist groups (as with Al Qaeda today), but some nations might see expansion of asymmetric warfare capabilities as the only way to protect themselves against U.S. domination” ([Sandia 2003](#), pg. 24).

In his testimony to Congress, Dr. Fingar (2008) stated that the NIC is exploring the geopolitics of climate change and how that may shift the relationships between major powers.²⁰

An increase in immigration – Almost one-fourth of the countries with the greatest percentage of population in low-elevation coastal zones are our neighbors in the Caribbean. Increased extreme weather events in this region could contribute to humanitarian disasters and the possibility of large-scale refugee flows and state failure. Also at risk, both Haiti and Cuba have historically used the threat of migration to extract concessions from the U.S. ([Busby 2007](#); [Lennon 2007](#)). The rate of immigration from Mexico is also likely to rise as climate change worsens this country’s already marginal water situation ([CNA 2007](#)). The U.S. needs to anticipate and plan for these growing immigration pressures ([Fingar 2008](#)).

¹⁶ Primary infrastructure needs to support Arctic shipping include: environmental predictions; charts and aids to navigation; availability of reliable communications; availability of fuel, water, supplies; salvage capability in ice-laden waters and ports of refuge for disabled ships; knowledgeable and experienced mariners to crew ships; search and rescue capability; pollution response capability, and regulations for Arctic navigation (NDU 2008; Navy 2007).

¹⁷ This report is limited to USCG distribution. Reported in <http://www.uscg.mil/cgjournal/message.asp?Id=66>.

¹⁸ Reported in <http://www.defensenewsstand.com/show.asp?docid=NAVY-21-32-4>.

¹⁹ Reported in www.navitime.com/news/2008/10/cg_polarstar_101608w/.

²⁰ This was partially explored in the NIC [Global Trends 2025, A Transformed World](#). In this study, climate change provides a pivot point that leads to a global scenario illustrating the effects of inattention to global change and how unexpected, major impacts could narrow the world’s range of option ([NIC 2008](#)).

Most at risk—Africa – U.S. interests in Africa have strengthened with that continent’s growing oil exports and worries about terrorism (Busby 2007). Increased political instability will make access to African trade and resources, on which the U.S. is reliant for both military and civilian uses, a riskier proposition (CNA 2007).

Many African nations can best be described as failed states and many regions are largely ungoverned by civil institutions. Many are already vulnerable to water shortages that exacerbate local grievances and can contribute to conflicts. Sub-Saharan Africa is the most climate vulnerable region because of its multiple existing environmental, economic, political, and social stresses (Fingar 2008; Busby 2007).

The likely need for increased stability operations, ranging from humanitarian direct delivery of goods and the protection of relief workers to establishment of stable and reconstructed states, will place heavy demands on the U.S. The U.S. must increase its focus on enhancing the capacity of weak African governments to better cope with societal needs and to resist the overture of well-funded extremists to provide schools, hospitals, health care, and food (CNA 2007).

Disaster preparedness and response – The U.S. will increasingly be sought as a global “first responder” in the immediate aftermath of a major natural disaster or humanitarian emergency. If and how to respond will be a recurring question, each time raising a difficult set of issues with important national security and foreign policy implications (CNA 2007; Lennon 2007). How much financial assistance should the U.S. pledge and how quickly? With which other countries should the U.S. seek to coordinate its response, either operationally or diplomatically? Should the U.S. military participate directly, and, if so, in what capacity and on what scale?

A switch in focus from disaster response to disaster preparedness is essential. Improvements in international forecast and warning systems must include the ability to identify areas of high vulnerability where disaster prevention and capacity building can be focused ([Army War College 2008](#)).

Preventive defense and peace building – Environmental security issues such as climate change are excellent candidates for preventive defense ([Butts 2008](#); [UNEP 2005](#)). National security policies targeted at adaptation,²¹ most notably risk-reduction and preparedness policies at home and abroad, could spare the U.S. the need to mobilize its military later to rescue people and to prevent regional disorder—and would ensure a more effective response if such mobilization was nonetheless necessary. Not only do the processes of working with multiple stakeholders to craft and implement adaptation (and mitigation) policies provide opportunities to advance American security interests, such efforts promote greater regional cooperation and confidence building (Busby 2007; CNA 2007). They also provide a mechanism for integrating all elements of national influence in advancing nations’ climate resilience. Increased priority should be given to funding for such integral agencies as the Department of State (DoS) and the U.S. Agency for International Development (USAID), together with a strong mandate for interagency cooperation (Butts 2008).

Climate change also creates opportunities for cooperation and tension reduction ([Army War College 2008](#); [Butts 2008](#)). Countries that would otherwise never gather around a negotiation table are now engaged in regional efforts to forecast, mitigate, and if necessary respond to cataclysmic natural disasters ([Army War College 2008](#)). The Middle East and Africa, for example, are two climate stressed regions that provide the essential resources for both the U.S. and Chinese economies. The U.S. and China, therefore, share a common interest in maintaining stability and ensuring dependable access at reasonable prices. Their cooperation on mitigating the effects of climate change and encouraging the development of adaptation capabilities in mineral producing regions could serve as confidence building measures between the two powers (Butts 2008). In general, countries engaged in developing regional response capabilities to address a set of common concerns may be building a foundation for continued cooperative endeavors.

Training and readiness – The U.S. military takes pride in the effort it makes to train and prepare its young personnel for their missions. How will increased demands for military involvement in immigration control, disaster preparedness and response, preventive defense and peace building alter the needed curriculum? Does recruiting need to change in order to draw into its ranks new types of personnel? Does officer training

²¹ Adaptations are actions taken to help communities and ecosystems moderate, cope, or take advantage of actual or expected changes in climate conditions ([USAID 2007](#)). In the coastal city of La Ceiba, Honduras, for example, flooding, storm surges and sea-level rise are being combated by an urban drainage system, higher levees, watershed restoration, lining the river bed, and building channels through the city to divert flood waters.

need to include additional specialities so that officers can develop techniques for negotiation and conflict reduction?

International perceptions of the U.S. – U.S. leadership in the overall global arena will be judged by the extent to which it is perceived as forging a viable and effective global consensus for tackling climate change (Fingar 2008; [Gleick 2006](#); Sandia 2003). Similarly, the U.S. ability to assume a leading role in organizing the relief operation in the immediate aftermath of any natural disaster will contribute considerably to future perception of America ([CSIS & CNAS 2007](#)). The very global nature of climate change necessitates multiple types of international cooperation, providing opportunities to strengthen U.S. international relationships.

4.3 Domestic Impacts

The U.S. is better equipped than most nations to deal with the climate change impacts and may even see a near term benefit owing to increases in agricultural productivity ([Blair 2009](#); [Fingar 2008](#)). The adverse consequences that are expected range from border stress due to the severe effects of climate change in neighboring countries to an increase in wildfires throughout the longer summers (Fingar 2008; [Lennon 2007](#)). The expected increase in storm severity along the Gulf and East coasts has received the most attention, in part because some of our most critical infrastructure for trade, energy, and defense is located on our coasts ([Truly 2007](#)).²²

The concentration of human settlements near the coasts justifies many risk-reduction and adaptation policies. These can be chosen to provide benefits even should the effects of climate change prove to be modest. Government incentives for industry and individuals to reduce risk through improved building codes, for example, can increase resilience to floods, high intensity storms, terrorist attacks and other dangers ([Busby 2007](#)). Similarly, changes to federally funded disaster insurance that discourages dangerous coastal settlements can also reduce further damage to vulnerable coastal ecosystems. The possibility that increasingly intense tropical cyclones will force the resettlement of large numbers of people away from coastal areas must be addressed (Lennon 2007). This could have wide ranging implications, touching on everything from changes in the political mapping within the country to the industrial base. A substantial rise in sea levels²³ could also lead to a massive depopulation of coastal regions, along with widespread damage to New York, California, and other core industrial and agricultural regions ([CSIS & CNAS 2007](#)).

There are a number of recent studies on climate change vulnerability and potential impacts in the U.S. Some are relatively high-level assessments.²⁴ Some consider how several types of climate impacts might affect a particular sector, such as transportation or energy production or regions.²⁵ Others consider a particular consequence, such as human health and welfare or impact, such as extreme weather events.²⁶ This body of work varies widely in approach and level of detail. Since the number of studies will undoubtedly continue to increase, some form of clearinghouse function is required to provide a common standard for assessing the quality, datedness, and potential application of these works, together with a mechanism for ensuring their wide availability, as appropriate.

4.4 Strategic Initiatives Needed

Responding to climate-related security threats requires the integrated application of all instruments of national power. Economic and informational power will be key drivers of climate change responses as they provide the needed resources, ideas, and technology. It should be through invoking both diplomatic and military power that diminishing resources are allocated and new ideas are implemented to overcome climate challenges ([Maybee 2008](#)). All agencies involved with climate science, treaty negotiations, energy research,

²² Two-dozen nuclear facilities and numerous refineries are located in U.S. coastal areas (Fingar 2008).

²³ Current estimates for global average sea level increase are on the order of 1 m by 2100 ([Carlson 2008](#), 2009, [NASA 2006](#), and [Richardson 2009](#)). Regions such as the U.S. east coast are expected to see a higher than average rise.

²⁴ For example, see NTSC ([2008](#)); USGCR ([2009](#), 2000).

²⁵ For example, CCSP ([2009](#), [2008a](#), [2008b](#), [2008c](#)); Ebi ([2007](#)); NRC ([2008](#)).

²⁶ For example, see CCSP ([2008d](#), [2008e](#)).

economic policy, and national security should participate in an interagency process to develop a deliberate policy to reduce future risk to national security from climate change ([CNA 2007](#)).

National security planning – There is a current lack of guidance to ensure that the necessary planning occurs in a timely and integrated manner (Butts 2007; CNA 2007; [Busby 2007](#)). The extent to which the new National Security Directive under development by the NSC will fill this gap is uncertain.

Climate change introduces new levels of uncertainty into strategic planning: uncertainty about the changes in physical climate and earth systems, their interactions with environmental and societal systems, and how the results may create or affect existing regional tensions and instabilities ([Army War College 2008](#)). Research is needed to determine (1) where U.S. security interests are threatened, (2) how these threats should be addressed and by which organizations, and (3) the resources that will be required. This information is needed to inform a new National Security Strategy ([Butts 2007](#)).

The speed with which the climate is changing requires some planning to proceed in parallel with research activities. As a next step, the intelligence community could conduct a comprehensive review of climate change threat parameters and prepare strategic threat documents or approaches that identify potential missions and operations, the information demands and associated collection tasks and priorities, and the required capabilities.²⁷ Scenario development will be an especially valuable tool given the high levels of uncertainty involved and the need to examine complex interactions among climate, environmental, social, economic, cultural, political, and other pertinent factors. Scenarios should be jointly developed by all of the civilian and military agencies – including DoS, Homeland security, Intelligence agencies and DoD. Each agency brings a different critical dimension to the scenario development process. Families of scenarios can be used for additional purposes, such as evaluating the capacity of the military and other institutions to respond to the consequences of climate change (CNA 2007). A better understanding of the applicability, effectiveness, and costs of different forms of adaptation is another critical input to planning activities.

In addition to anticipated high impact, high probability scenarios, such as widespread water scarcity, planning should balance high impact, low probability scenarios with low impact, high probability ones ([Butts 2008](#)). Addressing the high probability “close in” scenarios will entail providing critical support to sustainable development and the actions necessary to prevent failed states. Early action will pay immediate benefits and provide a high return on investment. It can also create a framework for monitoring and addressing potentially catastrophic low probability, high impact scenarios. Planning for these latter events is critical to identify the long lead-time responses necessary to ensure U.S. national security interests. In both cases, alternative approaches and cost-benefit assessments must be run to establish what can be done, when, and at what cost. Multinational support will be essential to respond to increasing numbers of simultaneous crises around the world and it is important that planning is conducted in collaboration with other nations, IGOs, and nongovernmental organizations (NGOs) (Army War College 2008; CNA 2007).

In addition to developing new plans to respond to climate-induced threats, existing plans must be revisited to ascertain their ongoing validity in the face of climate changes. Mechanisms should be put in place to trigger future reviews with major steps in our understanding of climate, environmental, and societal sciences.

Assessments to support planning – It is vital to identify those regions in the world that are most vulnerable to climate change stresses and that will most affect U.S. national and international security, behavior, and policy (Butts 2008; [Busby 2007](#); [Gaffney 2008](#)). The specific threats will depend on the dynamics of climate change, local environmental and societal conditions, and the affected societies’ and actors’ crisis management capacities (Butts 2007; [Schubert et al. 2008](#)). At this time, the present level of scientific understanding of future climate change lacks the resolution and specificity needed for detailed analysis at the state and regional levels ([Lane 2008](#); [Lennon 2007](#)). The complex interrelationships among important factors are ill understood and considerable research is needed to understand the ways in which climate change impacts, environmental, geopolitical, and societal factors are likely to play out in specific regions, countries, and localities ([Smith and Vivekananda 2007](#)). Additionally, there are many regions where data on vulnerabilities are unavailable or limited. The capacity of individual governments to mitigate or adapt to

²⁷ The National Intelligence Council NIA provides a starting point ([Fingar 2008](#)). Ideally, new threat assessments will be structured to maximize the amount of information that can be widely shared.

climate change affects will be difficult to discern and a proper topic for intelligence community research (Butts 2008).

Two military-sponsored research efforts are taking a step in this direction. In 2007, the U.K. Ministry of Defence (MoD) initiated a multi-year £100 million program to investigate the dynamics of long-term climate change, the links to international poverty, and the likely impact of climate change on conflict and other factors ([UK 2008](#)). Under its [Minerva Initiative](#), DoD recently funded a Climate Change, State Stability, and Political Risk in Africa program at the University of Texas (UT). Additional information about the UT program is not available but the initiative itself seeks to better understand the factors and causes behind social changes that lead to the rise of violent extremism and failing states.

The NIC plans to examine the potential effects of climate change on a set of countries and world regions to identify the resulting impact to U.S. security interests (Gaffney 2008).²⁸ The MoD effort includes a detailed analysis, region by region, to identify where climate change could contribute to conflict and security threats, and the conditions under which British forces might be deployed in the future. These are part of a growing library of studies that has assessed regional and country vulnerability to climate change impacts, as well as how this vulnerability might exacerbate instability and disputes over scarce resources.^{29, 30, 31} An additional body of studies has addressed related topics, such as water and food scarcity, and may provide useful inputs to assessments. The value of this work for planning purposes has yet to be ascertained. Many studies were exploratory in nature and few, if any, were guided by decision-makers' needs. Here, again, a federally sponsored clearinghouse function would facilitate optimal use of studies to support decision makers' needs.

In a somewhat different vein, in 2008 the National Academy of Sciences established a Committee on Climate, Earth, and National Security.³² This committee is intended to be a source of strategic guidance to national security-related climate change, environmental science, and natural disaster research over a two-year period. Its goal is both to advance scientific understanding of global climate and other environmental and disaster-related phenomena, and consider the implications for both fundamental scientific understanding and national security.

Continuous monitoring – Monitoring of environmental anomalies that might lead to food and/or water scarcity may provide opportunities to prevent or contain conflicts. Similarly, conflict-prone zones should be monitored to limit increased exposure to destabilizing environmental factors (Army War College 2008; [AEPI 2007](#)). A first step will be to develop key climate impact indicators for both vulnerable natural environments (e.g., desert fringe environments, low lying coastal areas, historical breadbasket regions and glaciers) and geopolitically sensitive areas (e.g., sub-Saharan Africa, Middle East and China) ([Gaffney 2008](#)). These could be integrated with indicators of propensity for state instability, environmental sustainability, human health and development, natural disasters and the like (Lynch 2009). The maturity of these varies considerably, as does their support through real-time monitoring systems. Among these, natural disaster indicators are the best

²⁸ The NIC will also conduct a scenario exercise and report on the potential national security impacts from possible climate change remediation strategies (carbon capture and sequestration, bio fuels, a family of renewables, or nuclear power).

²⁹ The United Nations Framework Convention of Climate Change [National Adaptation Programmes of Action \(NAPA\)](#) is a source of information about the vulnerabilities and urgent adaptation requirements of Least Developed Countries and Small Island Developing States.

³⁰ Some have taken a global or large-scale geographical view combining, for example, projections for sea level rise with risk factors for political instability to identify countries of concern; for examples see ([Asia Society 2009](#); [Baettig et al. 2007](#); [Brown 2009](#); [Hug and Ayes 2007](#); [Levy 2008](#); [Smith and Vivekananda 2007](#)). Others provide a more detailed assessment for a particular country; for examples see ([Brauch 2002](#); [Freimuth et al. 2007](#); [Hendrix and Glaser 2007](#); [Pai 2008](#); [Reid et al. 2007](#); [Solana 2008](#), [Schubert et al. 2008](#); [UNEP 2007](#); [UNEP 2005](#)). Some studies consider particular stress factors, for examples see ([Kelman 2006](#); [Michel 2009](#); [Niasse 2005](#)); or consequences such as migration, for examples see ([Brown 2007](#); [Cornejo 2007](#); [Warner 2009](#)).

³¹ An additional body of studies has assessed related topics, such as water and food security. For examples, see FAO ([2008](#); [2007](#)); UNESCO ([2009](#)); Wolf ([2007](#)).

³² See the project web page at: <http://www8.nationalacademies.org/cp/projectview.aspx?key=49017>.

understood and supported by real-time monitoring systems. Most other types of indicators require further validation and, as appropriate, data collection and analysis support.

The intelligence community needs to be part of the larger community in developing and monitoring “new” indicators.³³ Policy supporting shared situational awareness across a broader community will facilitate integrated observations.

Information-sharing partnerships – Much of the climate-related information needed for planning activities will come from nontraditional and open sources. As a first step, the intelligence community needs to communicate its information needs and build the linkages with the scientific community that will ensure planning is based on the latest understanding and data. Information sharing can be problematic for the intelligence and military communities. Improved methods for passing appropriate information across security barriers and providing it to civilian-led operations are needed.

Shared situational awareness implies more than data transparency. It demands a new kind of network that is not constrained by classification and a new emphasis on the value of available unclassified open source data. Previously unreleased data and information from national security systems may help civil scientists get a fuller or clearer understanding of perceived climate change signals (Gaffney 2008). Even so, the biggest change will probably not be the increased sharing of unique military intelligence data but the relevance and ingestion of non-military intelligence data to security missions.

4.5 Coordination, Both National and International

Despite differences in nations’ views of the severity of climate change impacts and their own strategic goals, there is universal agreement on the urgency of building developing countries capacity to adapt and prosper in the face of climate change. In this way, the long-term climate change “crisis” can serve as a unifying force internationally, prompting nations to forge alliances focused on fixing or adapting as a larger group. The U.S. has many years of experience in conducting cooperative climate change programs. Cooperative programs with India, for example, are investigating vulnerability and adaptation, as well as climate science, clean energy, and transportation ([USAID 2002](#)). Increased attention, however, is required to optimize collaborations within and across governments. Effective interagency action, for example, may require new legislation and better definition of Department of Homeland Security authority ([Army War College 2008](#)).

The U.S. needs to expend additional effort in attempting to identify the right partners and developing the relationships, collaboration processes, and systems that will facilitate easy and rapid mutual leverage and support. Scenario development would help to identify partnerships needs, whereas additional events like the [Cloud and Climate Change](#)³⁴ war game held July 2008 could serve as valuable vehicles for collaboration building.

Current efforts at coordination are hindered by a lack of visibility into climate-related activities at both national and international levels. An inter-agency climate change operations center with responsibilities for providing stakeholders with a continually updated “common operating picture” of climate change status, stakeholders, and related activities worldwide would be a valuable tool for ongoing, effective cooperation.³⁵

³³ The 4-year [European Global Monitoring for Security and Stability \(GMOSS\)](#) provides an example of leading research and challenges. See reports available at: <http://isferea.jrc.ec.europa.eu/Activities/ProjectPortfolio/Pages/GMOSS.aspx>.

³⁴ This international war game was conducted by a consortium of 10 partner organizations and hosted by the Center for a New American Security ([CNAS 2009](#)).

³⁵ As an aside, important congressional oversight on federal responses to the climate challenge are difficult to follow since climate change touches on the potential jurisdiction of a number of different committees. The [House Select Committee on Energy Independence and Global Warming](#) was created in 2007 to focus climate and energy policy. Even so, there is no single point of entry, or support for viewing climate-related activities across congressional committees that would help in following lawmakers’ concerns and the legislative progress.

5. Issues for Department of Defense

The FY2008 NDAA requires that the next National Defense Strategy and Quadrennial Defense Review (QDR) take account of climate change. The FY2010 QDR is underway and its terms of reference do identify climate change as one of the trends that increase the complexity of today's strategic environment ([DoD 2009](#)). Figure 9 lists the climate change-related questions that DoD is considering during the review. As the figure shows, energy security is tightly coupled to questions about climate change.

Also at this time, the selection of a senior DoD official for climate change-related concerns is underway, although details about the responsibilities and authorities that will accompany this position have yet to be released.³⁶

In this section we look first at how changes in the Arctic are expected to impact DoD: a topic that has seen a relatively large amount of attention. Then the consequences of climate impacts in other parts of the world are considered in terms of potential changes to DoD missions and roles; the need to strengthen existing alliances and build new partnerships; increased stresses on military personnel, bases, equipment, and systems; and, lastly, DoD planning.

1. What role should DoD play in our nation's response to climate change?
2. What capabilities will DoD need to support civil authorities in effectively responding to climate change events?
3. What capabilities and capacity will DoD require to build partner capacity to adapt to climate change?
4. What specific risks does climate change pose to DoD installations?
5. How might DoD mitigate energy supply risk to widely dispersed forces engaged in cooperative security or irregular warfare?
6. How might DoD mitigate its dependence on the U.S. commercial grid from critical infrastructure and missions?
7. What acquisition or business process reforms might improve DoD's energy posture?

Figure 9. Climate Change Questions for the QDR ([Goodman 2009](#))

5.1 In the Arctic

Certainties of increased Arctic access, emerging sovereignty and territorial disputes, and additional oil and natural gas exploration require a military presence in the Arctic to preserve U.S. national security interests ([Burd 2006](#)). The naval community has participated in a series of symposia on the [Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations](#).³⁷ The first symposium was held in 2001, the second in 2007, and a third was scheduled for this June. Their conduct has included in-depth considerations of future surface and subsurface Arctic missions, operationally driven capability requirements and shortfalls, and strategy and policy issues ([Navy 2001](#), [Navy 2007](#)). The Arctic missions identified include: maintaining a maritime presence to reinforce U.S. jurisdictional claims, defense and homeland security readiness, global mobility, safeguarding oceans and resources, and supporting polar research. The newly released internationally-developed [Arctic Marine Shipping Assessment \(AMSA\) 2009 Report](#) and [Arctic Offshore Oil and Gas Guidelines](#) provide additional details about the Arctic operating environment out to 2020 (Arctic Council [2009b](#); [2009c](#)).

A common point in the findings of the various symposia and studies is that harsh Arctic conditions necessitate extensive cooperation among military forces, other governmental agencies, academia, and commercial stakeholders. These groups have variously assessed the areas of Arctic science, technology, equipment, and systems that need further development and are unanimous in pointing out that current Arctic marine infrastructure is inadequate for safe shipping, environmental protection, and emergency response.

³⁶ Statement by Dr. Butts at [The First Conference of the IISS Transatlantic Dialogue on Climate Change and Security](#), May 5, 2009, Washington, DC.

³⁷ These symposia were sponsored by and/or had participation from several offices within the U.S. Navy as well as the DoI, Minerals Management Service; National Aeronautics and Space Administration, Cryospheric Sciences Program; NOAA; National Science Foundation, Office of Polar Programs; U.S. Arctic Research Commission; USCG; USGS; and the White House Office of Science and Technology Policy.

In 2007, the Navy reported that mechanisms for joint operations in the Arctic did not exist (Navy 2007), much less plans for interagency and combined operations. Near term activities are urgently needed to gain a better understanding of the implications of such cooperation. An initial step could be to conduct planning exercises for interagency and combined response to emergency and security response scenarios such as a sinking Russian nuclear icebreaker; confrontation with international smuggler, poacher, or pirates; terrorist attacks against oil rigs; and a large-scale pollution incident ([NDU 2008](#)). The lack of maturity in planning for Arctic emergency and security response scenarios is particularly worrying given the increasingly northward movement of the Arctic cruise ships and commercial development (Navy 2007; NDU 2008).

For the DoD, preparing for increased Arctic missions is complicated by the fact that there are three Combatant Commands (COCOMs) with Arctic responsibilities: U.S. European Command, U.S. Northern Command, and U.S. Pacific Command (Burd 2006; Navy 2001; NDU 2008), a circumstance not addressed in the new NSPD-66. A single unified Arctic command would simplify both decision-making and cooperation with other stakeholders.

5.2 Impact on Non-Arctic Roles and Missions

The speed at which the climate is changing is a strong indication that the U.S. will be drawn into stability operations around the world more frequently in the future ([CNA 2007](#); [USJFCOM 2007](#)), particularly since DoS and USAID do not have the resources for these types of activities ([Butts 2007](#)).

Environmental security and disaster prevention, response, and recovery are now looked upon as acceptable military missions in that they are viewed as essential elements of regional stability. Climate change fits neatly into this framework. The new QDR will reportedly provide guidance on U.S. outreach to foreign military forces to build their capacity to cope with the negative consequences of climate change.³⁸ DoD should additionally direct the COCOMs to consider climate change as a primary engagement issue with the purpose of increasing the resilience of vulnerable local communities (Butts 2007; [Busby 2007](#); CNA 2007; [Sigler 2008](#)). Efforts such as these must be synchronized and coordinated with the appropriate regional and international organizations. As an initial step, the Army Corps of Engineers, for example, should consider worldwide collaboration with counterparts and international organizations to determine priorities on which communities need what kind of help from a network of state and international agencies ([AEPI 2007](#)).

There is a danger that DoD's capability for rapid response and its experience in operating in environments with minimal infrastructure will result in DoD being viewed as the "Mr. Fixit" of the U.S. climate change response (Butts 2007). Although the international community is very dependent on U.S. capabilities, DoD is not always the "first responder" nor always in a position of having the most knowledge about a situation. Many other organizations already have the knowledge and expertise required to complement DoD's logistics and communications capability. DoD should play a supporting role—plugging gaps where appropriate but not remaining in charge ([Army War College 2008](#)). Increased acceptance within the military that military tasks are in support of civilian-led emergency response will assist greatly in achieving a compatible culture in the field (Butts 2007).

DoD's strengths may also be key for minimizing the disruptions that can accompany large-scale migrations. Possible tasks range from conducting surveillance of long borders to surveying large areas with the goal of determining where displaced people are and assessing their needs so that supplies can be pushed forward (Army War College 2008). This is another area where DoD might find itself working with new partners and integrating its efforts in new ways.

With its worldwide data collection capabilities, including those in regions not readily accessible to others, DoD can significantly contribute to the development of climate change science. The importance of climate information for military planning and operations is only likely to increase, so it is in DoD's best interests to engage with climate scientists to identify the aid that can be provided without detriment to its primary missions.

³⁸ Reported in http://www.insidedefense.com/secure/display.asp?docnum=682009_june8b&f.

5.3 New Partnerships

International interagency cooperation is ongoing and already addressing the security dimensions of many climate change issues ([Butts 2007](#)). DoD cooperation with partner countries, for example, has been regularly supported by agencies such as USAID, the U.S. Geological Society, the Environmental Protection Agency, and DoI. These activities build partner capacity and capabilities to address environmental security issues and promote stability. In particular, the COCOMs have large planning staffs, solid command and control capabilities, and an infrastructure to move personnel, equipment, and supplies. This gives them a natural advantage over their civilian counterparts (Reveron 2006). Their job is to build partnerships and thereby increase security. More often than not today they find it is more effective to negotiate and influence the direction of other countries than to respond to a full-blown military crisis. For example, during his tenure as Pacific Command, Admiral Dennis Blair advocated a multilateral approach to regional security that “concentrates on shared interests, peaceful development, and actively promotes diplomacy and negotiation to resolve disagreement” ([Jordan 2003](#)). Understanding this new perception of COCOMs’ role is vital to appreciating how relevant they will be in determining how the world will adapt to global change.

DoD is also keenly aware of the capabilities that NGOs bring to development and disaster relief operations, including access to information and background unavailable to governmental organizations. However, the cultural sensitivities and political nuances inherent to the nature of NGO interaction with populations in developing areas can hinder their close association with any individual government (particularly the U.S.) ([Army War College 2008](#)).

The potential scale of adverse impacts and the likelihood of multiple simultaneous crises will require resources beyond those available from existing partners ([Maybee 2008](#); Army War College 2008). Increased collaboration with civilian agencies, the private sector, and civilians, both domestic and foreign will have impacts ranging from policy to communications (Army War College 2008). Early identification of potential future partners will be critical in providing DoD with the time needed to build the relationships, collaboration processes, and systems that will be necessary.

5.4 Stress on DoD Capacity and Capabilities

The anticipated increase in international humanitarian emergencies could significantly tax U.S. military transportation and support force structures, resulting in a strained readiness posture and decreased strategic depth for combat operations ([Army War College 2008](#); [Fingar 2008](#)). At the same time, increased stress on U.S. borders and domestic missions will lower the availability of Guard and Reserve forces that are already stretched by current military operations ([CNA 2007](#)). There is also the concern that U.S. forces may have to operate where the environment is the greatest challenge—or even the weapon of the enemy’s choice ([AEPI 2007](#); [Sigler 2008](#); [Woolsey 2007](#)).

Higher intensity storms and increased frequency in temperature and precipitation extremes will stress personnel and equipment. Severe northern Atlantic storms, for example, increase transit times, contribute to equipment fatigue, and hamper flight operations (CNA 2007). In other regions, increases in dust storms, atmospheric interference, and heavy precipitation events may compromise both human and system performance. These types of concerns must be included in contingency plans, as well as in future system acquisitions (AEPI 2007).

Some U.S. national security interests are in countries that are particularly vulnerable to climate change impacts. These interests range from military bases and embassies to sites of major transportation corridors and military ports. A number of active coastal military installations in the continental U.S. are at a significant and increasing risk of damage from worsened storm surges in the near-term ([Busby 2007](#); CNA 2007; Fingar 2008; [USJFCOM 2007](#)). As key installations are degraded, so is the readiness of U.S. forces. A global basing posture review is needed to identify the risks and guide the development of contingency plans that ensure continued operational capability (CNA 2007). The Pentagon recently initiated an effort to [Assess the Impact of Sea Level Rise on Military Infrastructure](#). This study will develop the analysis methods needed to assess the impacts of local mean sea level rise ranging from 0.5 to 2.0 meters on DoD installations

worldwide.³⁹ The impacts to be considered include loss or damage to mission essential infrastructure as well as loss to transportation means, facilities, and/or corridors.⁴⁰

For DoD, climate change is a driver for environmentally efficient and operationally less costly weapons systems, research and development, and sustainable base management ([Butts 2007](#)). Several ongoing efforts are endeavoring to reduce energy usage and switch over to renewable energy sources.⁴¹ Nonetheless, DoD is almost completely dependent on electricity from the national power grid to power critical missions at fixed installations and on fossil fuels to sustain combat training and operations. The distribution systems for both types of energy sources are susceptible to damage from extreme weather (CNA 2007). The extent of this vulnerability is not yet fully understood; studies on the effects of increases in severe weather events are limited to restricted regions and/or a single type of infrastructure ([CCSP 2008a](#); [ICF 2007](#); [Paskal 2009](#); [SERDP 2009](#); [USARC 2003](#)).

5.5 DoD Planning

Climate change adds a new layer of complexity to DoD planning. Melting icecaps, rising sea levels, and loss of habitable space are anticipated to create new geopolitical areas of concern and may require major adjustments to how military planners project power, influence regional events, and secure forward basing ([Butts 2007](#)). The U.S. is import dependent so planners must also concern themselves with the competition for increasingly scarce resources and the effects of climate change on that competition ([Butts 2008](#)). The Middle East and Africa are two critical regions where the effects of global climate change are increasingly apparent,⁴² for example, and the U.S. finds itself competing with China for influence and minerals access in these regions. DoD's contingency plans should be reviewed and updated as necessary. Planning must also provide for the new roles previously identified, for example, in mass human migrations. DoD will benefit by including future mission partners in planning efforts and making personnel available for international planning conferences on key topics ([CNA 2007](#)). As a step toward integrating climate change into its operational planning and force structure and capability mix analysis, DoD should consider developing a framework for integrating climate change concerns into its scenario development process, for example, as a suite of vignettes in the "Steady State Security Posture." Scenarios could be a valuable tool for helping people to overcome difficulty in conceptualizing the potential scale and scope of climate impacts, particularly where environmental effects and their societal consequences can exhibit non-linear behavior (CSIS & CNAS 2007; WBGU 2008). They are additionally valuable for communicating the interconnected nature of climate change threats with other 21st century threats.

Except in the Arctic, many of the physical aspects of climate change are still subtle. Future changes are surrounded by considerable uncertainty. The uncertainty has several sources. Lack of scientific understanding about the physical atmospheric and earth systems and limitations in computer modeling capability are compounded by uncertainty about future greenhouse gas emissions. The present level of scientific understanding of future climate change lacks the resolution and specificity needed for detailed analysis at the state and regional levels ([Lane 2008](#); [Lennon 2007](#)). The ability to project changes over the next few decades is similarly limited. However, the prevailing scientific opinion is that current climate change projections are entirely too conservative. New sets of projections and associated impacts are urgently needed, especially the worst-case projections that are important for military planning (Lennon 2007). In the interim, planners should consider this tendency toward underestimation when examining current predictions of future climate parameters ([CSIS & CNAS 2007](#)).

³⁹ Installations to be assessed include Eglin Air Force Base, FL; Hampton Roads, Virginia Naval Installations (Naval Station Norfolk, Naval Air Station Oceana, Little Creek Amphibious Base); Marine Corps Base Camp Lejeune, NC; Naval Station San Diego and Naval Air Station North Island, CA; and Naval Station Pearl Harbor, Hawaii.

⁴⁰ The effects of sea level rise on New Orleans Naval Air Station Joint Reserve Base were briefly mentioned in the National Science and Technology Council's [Scientific Assessment of the Effects of Global Change on the United States](#) (NSTC 2008).

⁴¹ Militaries from around the world participated in [The Importance of Military Organizations in Protecting the Climate: 2008](#), a conference that demonstrated the military community's leading role in reducing use of fossil fuel energy sources.

⁴² For example, see UNESCO's [On the Frontlines of Climate Change](#) forum.

Special concern should be raised by the fact that previously predicted changes are occurring and are taking place on a time scale that is vastly different than the planning, programming, budgeting, or operational schedule within which DoD works. Changes are occurring at an accelerating rate. There are great uncertainties in our understanding of the implications of change. Our institutional response time is damped by uncertainty and may be taken by surprise by a whole new series of effects precipitated by these changes. It is going to be a challenge for DoD to adapt its planning cycle to this broad and unpredictable threat.

The uncertainty surrounding future climate change is a reason for disciplined analysis and decision, not for delaying decisions. Under uncertainty, knowledge has high value, and this makes the case for increased investment in applied climate science ([Garnaut 2008](#)). DoD not only needs to communicate its information needs to the scientific community, but it would also most likely be profitable for DoD to work with that community in determining or refining those information needs.

6. Key Issues Going Forward

Climate change effects will play an increasingly serious role in international and national security over the next several decades. Responses to changes in the Arctic are the most developed, although we have yet to see how federal agencies and departments will implement the new Arctic security policy and there are very significant equipment shortfalls. More generally, the two most critical (and related) issues at this time are:

Critical issue: Lack of U.S. policy that directs the application of all elements of national power in response to climate related security threats and opportunities throughout the world.

Promoting regional stability through increasing vulnerable countries' resilience to climate change effects should be a cornerstone of this policy.

Critical issue: Inadequate consideration of climate change effects in security and defense planning.

In the midst of much uncertainty, some near-term adverse effects can be predicted with confidence, for example, the impacts of flooding in the Niger Delta on settlements, economics, and health ([Uyigue 2009](#)). For the rest, planning should focus on developing a capacity for flexibility in the face of a turbulent world.

While the chronic instability climate change effects may foster is obviously worrying, the clear and present dangers of current conflicts inevitably command more attention. That said, evaluations of where climate change stands among other threats vary markedly, in part because it will affect different nations to different degrees and in different ways and also because of differences in interpretation of the scientific evidence ([Army War College 2008](#)). Other than in the Arctic, climate changes are still relatively subtle and there is a lack of understanding about the extent to which the rate of temperature increase is projected to accelerate in the second half of the century and of the potential for non-linear changes. U.S. decision-makers need guidance on how to include climate change in weighing trade-offs among competing objectives and values. How should environmental crises be balanced against other security threats?

Although we anticipate that the NSC's new national security directive will establish some level of climate-related security policy, it will likely be some time before that policy is released. It has been reported that the FY2010 QDR will provide guidance on U.S. outreach to foreign military forces to build their capacity to cope with the negative consequences of climate change, but it remains to be seen what additional guidance will be included. Since building the capacity to adapt to and prosper in the face of adverse climate change effects will take major resources and years to achieve, the underpinning policy development and planning cannot be postponed. Several near-term studies could support both the development of policy and interim decision-making:

- ***Establish a timeline of important effects and their potential consequences.*** This timeline would establish a common baseline for analytic activities. It would indicate, for example, when projected increases in the severity of Atlantic storms could significantly affect force projection, the rise in sea levels could hinder operations in major ports, and increasing desertification could make a region uninhabitable.
- ***Conduct a comprehensive review of climate change threat parameters that maps out the possible action space and builds a robust decision-making framework.*** This framework is needed to support the defense, diplomatic, and intelligence communities, to name a few, in better understanding what aspects of climate change, in what combination, aggregated with the already complex economic-political reality, could drive decision makers to alternative considerations. Another important outcome would be an increased ability to anticipate important questions such as what role the U.S. should play if the continued migration of Han Chinese into Eastern Siberia causes a major increase in tensions between the two nations.
- ***Conduct scenario planning exercises to identify how climate change effects might stress military, diplomatic, and other U.S. missions in the near and mid future.*** Defense Planning Scenarios (DPS) that examine plausible futures in 7-plus and 20-plus year timeframes are a valuable vehicle, especially given the high levels of uncertainty involved, need to examine complex interactions among multiple factors, and requirement of communication among diverse stakeholders.

Uses of scenarios themselves include assessing different courses of action and determining future capability needs that driving, as necessary, current procurement actions.

Additionally, *existing DPS require reexamination to assure their continued validity* in the face of anticipated climate-related challenges.

- ***Identify a set of climate-related adaptation actions that (1) meet existing needs and/or (2) resolve multiple problems.*** The provision of potable water is a prime example. Many parts of the world already suffer from critical water shortages that climate change will exacerbate.⁴³ The military's capacity for water desalination and purification is limited and heavily reliant on the use of diesel engines. New desalination and purification technology could benefit humanitarian and disaster responses, relieve the military's logistics burden, and reduce CO₂ emissions as well as mitigating current and future water shortages. In addition, government agencies should review their development and other aid programs and policies to identify instances where relatively minor revisions would benefit adaptive capacities.
- ***Identify gaps in the information needed by policy and other decision-makers.*** Gaps that are a consequence of current limitations in climate science are unlikely to be resolved in the immediate future. Nonetheless, communication between decision-makers and scientists from several disciplines should be established so that (1) scientists are better informed about decision-making needs and (2) decision-makers better understand the appropriate uses of available information. This determination would additionally better position the security community to communicate its information needs to the proposed [National Climate Service](#) when established and other stakeholders.⁴⁴

Other than extreme weather events that trigger humanitarian crises, most climate change effects accumulate over time until, in some situations, a critical level of stress is reached that triggers significant changes in societal behaviors. Thus:

Critical issue: Lack of the integrated indicators that support monitoring of climate change effects to identify windows of opportunity for interdicting developing security crises and/or promoting peacebuilding. A capability to monitor how ongoing physical climate changes interact with evolving regional societal, economic, and political realities can serve multiple purposes. It provides the "ground truth" that drives actions taken to promote global stability and prosperity, and against which policy effectiveness can be assessed. Also, importantly, monitoring of an integrated set of indicators and warnings (I&W) could provide some of the data needed to advance the maturing of "adaptation science."

Continuous monitoring of an integrated set of indicators is a prerequisite to timely interventions that forestall climate driven security crises. The identification of the parameter space of climate change threats provides the basis for a preliminary identification of I&W requirements. While there are many examples of longstanding I&W systems, these typically do not address the complex societal behaviors needed in this case.⁴⁵ Once I&W requirements are determined, it will be necessary to work with the research community to develop and validate new types of integrated indicators. A parallel effort should map the data space of existing I&W systems to assess opportunities for leveraging existing data collection mechanisms. At the same time, climate must be integrated into ongoing research on how environmental, geopolitical, economic, societal, and other factors can contribute to state instability or conflict ([Schubert et al. 2008](#)). This will be a long-term endeavor and a concerted effort to advance this research is advisable.

⁴³ Water scarcity, defined in terms of access to water, is a critical constraint to agriculture in many areas of the world. A fifth of the world's people, more than 1.2 billion, live in areas of physical water scarcity, lacking enough water for everyone's demands. About 1.6 billion people live in water-scarce basins, where human capacity or financial resources are likely to be insufficient to develop adequate water resources ([IWMI 2009](#)).

⁴⁴ In May 2009, the [H.R. 2407: National Climate Service Act of 2009](#) was introduced in Congress. This bill proposes establishing a National Climate Service at NOAA. A second bill, [H.R. 2685: National Climate Enterprise Act of 2009](#), was introduced in June specifying how the service should be organized. In particular, this second bill establishes an Interdepartmental Oversight Board, chaired by the White House Office of Science and Technology Policy (OSTP), which would set priorities and develop a cross-agency budget.

⁴⁵ Using current indicators of instability as examples, see Hewitt et al ([2009](#)) & FfP ([2009](#)) for global assessments of state instability and Tannehill ([2008](#)) for a more regional focus.

Throughout this paper, we have stressed how dealing with climate change effects will rely on knowledge and other resources that reside in multiple organizations. We do not have a strong history of effective interagency collaboration; indeed, U.S. government regulations and practices often hinder such behavior. Accordingly, the last critical issue we address is:

Critical issue: Need for unprecedeted levels of cooperation – both across organizational and national boundaries, and across scientific disciplines – where examples of effective interagency collaboration are few and far between.⁴⁶ Questions about roles and authorities, capability and capacity, transparency of goals and actions, and the always-thorny problem of classification need to be addressed.

In this resource-constrained world, it is difficult to imagine circumstances where the sharing of climate-related knowledge and resources will not ultimately be in the U.S.'s favor. *All of the studies and activities mentioned in this section would benefit from wide participation across the stakeholder community.* Here, again, some near-term actions offer significant benefits:

- **Gain visibility into diverse, national and international stakeholders, their goals and actions.** Stakeholders include U.S. and foreign governments, IGOs, NGOs, and local communities. There is a wealth of information about all these groups on climate-related portals and web sites,⁴⁷ not to mention those concerning human development, environment, health, humanitarian aid, and disaster preparedness and response. Policy and decision-makers require visibility into this information in a manner structured to accommodate the breadth and depth of their current interest. Comparable to a national climate service that provides a one-stop location for information about the current and projected climate, a stakeholder portal would provide decision makers with a single source, sustained capability to monitor the players and their actions. This capability to take a snapshot of current events at any given time is fundamental to (1) identifying and assessing alternative courses of actions and (2) determining the impacts of significant events and/or data on current and planned actions. A stakeholder portal would also enable identifying new sources of information and critical information gaps, needs for new forms of analysis, and opportunities for new partnerships. Linkages to international early warning systems and real-time information sources would further increase policy and decision makers' capability for anticipatory and effective response to climate change effects.
- **Promote awareness and appropriate use of the growing body of impact, vulnerability, and adaptation assessments.** It is difficult to navigate through the accumulating wealth of studies that are being conducted by governments, IGOs, NGOs, think tanks, and other stakeholders. A central clearinghouse function would (1) provide a single point of access, (2) a comprehensive indexing scheme that reflects policy and decision-makers' information requirements, and (3) standards for determining the completeness, datedness, and potential application of these works. Equally importantly, this clearinghouse would provide a central focus for determining the validity of extant findings following scientific advances or new data.
- **Develop policies that promote sharing of climate-related materials.** The preponderance of climate-related source information is in the open literature.⁴⁸ It is the results of analyses and planning that *may* be sensitive. Examination of past examples of both successful and unsuccessful attempts to share information across the boundaries of the security community might yield valuable insights into what needs to be done to ensure that unnecessary classification of source and other materials does not stop wide collaboration in its tracks.

This paper is one in a series that are examining understanding of climate change effects, their impacts, and the available options. Any questions about this series, or the sources and issues identified in this paper, can be addressed to C. Youngblut at youngb@ida.org.

⁴⁶ The Government Accountability Office site discusses problems and needed actions, see http://www.gao.gov/transition_2009/challenges/collaboration.php.

⁴⁷ For examples, see the [Adaptation Learning Mechanism](#), [International Research Institute for Climate and Society](#), and the [World Bank Climate Portal](#).

⁴⁸ It is possible that the ownership of certain data could reveal sensitive information about collection capabilities.

Acronyms and Abbreviations

AMSA	Arctic Marine Shipping Assessment
COCOM	Combatant Command
DPS	Defense Planning Scenarios
DoD	Department of Defense
Dol	Department of Interior
DoS	Department of State
EEZ	Exclusive Economic Zones
EU	European Union
FY	Fiscal Year
GPH	Gallons Per Hour
HA/DR	Humanitarian Assistance & Disaster Relief
HSPD	Homeland Security Presidential Directive
IDA	Institute for Defense Analyses
IGO	Intergovernmental Organization
I&W	Indications & Warnings
JFCOM	Joint Forces Command
MCDA	Military Civil Defense Assets
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organization
NDAA	National Defense Authorization Act
NIA	National Intelligence Assessment
NIC	National Intelligence Council
NGO	Nongovernmental Organization
NSC	National Security Council
NSPD	National Security Presidential Directive
ROWPU	Reverse Osmosis Water Purification Units
SERDP	Strategic Environmental R&D Program
TWPS	Tactical Water Purification System
U.K.	United Kingdom
UN	United Nations
UNCLOS	UN Convention on the Law of the Sea
UNHCR	UN High Commissioner for Refugees
U.S.	United States
USAID	U.S. Agency for International Development
USCG	U.S. Coast Guard
UT	University of Texas

References

AEPI (2007): "Climate Change and Army Sustainability." *Army Foresight: Searching for Sustainability Series*, Issue 4. Army Environmental Policy Institute. July 2007. Available at: <http://www.aepi.army.mil/foresight.html>.

Arctic Council (2009a): *Tromsø Declaration*. Available at: <http://arcticcouncil.org/filearchive/FINALDRAFTDECLARATION28APR09A4.pdf>.

Arctic Council (2009b): *Arctic Marine Shipping Assessment 2009 Report*. Arctic Council, April 2009. Available at: <http://www.arctic-council.org/filearchive/amsa2009report.pdf>.

Arctic Council (2009c): *Arctic Offshore Oil and Gas Guidelines*. 2009. Arctic Council. Available at: <http://arctic-council.org/filearchive/ArcticOffshoreOilandGasGuidelines2009.pdf>.

Arctic States (2008): *The Ilulissat Declaration*. Arctic Ocean Conference, Ilulissat, Greenland, 27–29 May 2008. Available at: http://www.oceanlaw.org/downloads/arctic/Ilulissat_Declaration.pdf.

Army War College (2008): *National Security Implications of Climate Change*. Report of workshop held May 13–14, 2007. Army War College, Strategic Studies Institute & Triangle Research Institute for Security Studies. Available at: <http://www.strategicstudiesinstitute.army.mil/pubs/display.cfm?pubID=862>.

Asia Society (2009): *Asia's Next Challenge: Securing the Region's Water Future*. An Asia Society Task Force Report, April 2009. Available at: <http://asiasociety.org/taskforces/water/>.

Baettig et al. (2007): "A climate change index: Where climate change may be most prominent." Baettig, M.B., M. Wild, and D.M. Imboden. 2007. *Geophysical Research Letters*, 35, L01705. Available at: <http://www.agu.org/pubs/crossref/2007/2006GL028159.shtml>.

Blair (2008): *Annual Threat Assessment of the Intelligence Community*. Dennis C. Blair, Director of National Intelligence, Statement to the Senate Select Committee on Intelligence, February 2009, Available at: <http://intelligence.senate.gov/090212/blair.pdf>.

Brauch (2002): "Climate Change, Environmental Stress and Conflict." Brauch, H.G. 2002. In *Climate Change and Conflict, Can climate change impacts increase conflict potentials? What is the relevance of this issue for the international process on climate change?* Federal Ministry for the Environment, Nature Conservations, and Nuclear Safety. Available at: http://www.afespress.de/pdf/Brauch_ClimateChange_BMU.pdf.

Brown & Crawford (2009): *Rising Temperatures, Rising Tensions, Climate change and the risk of violent conflict in the Middle East*. Brown, O. and A. Crawford. International Institute for Sustainable Development, 2009. Canada. Available at: http://www.iisd.org/pdf/2009/rising_temps_middle_east.pdf.

Brown (2007): *Climate change and forced migration: Observations, projections and implications* Brown, O. 2007. Human Development Report 2007/2008, 2007/17. United Nations Development Programme. Available at: http://www.iisd.org/pdf/2008/climate_forced_migration.pdf.

Burd (2006): *Global Warming and the Combatant Commander: Engaging the Arctic*. Burd, M.L. LCDR, USN. October 2006. Naval War College: Newport, RI. Available at: <http://handle.dtic.mil/100.2/ADA463334>.

Butts (2008): *Testimony of Dr. Kent Hughes Butts. Before the Joint Public Hearing of the Select Committee of Energy Independence and Global Warming and the Intelligence Community Management Subcommittee of the House Permanent Select Committee on Intelligence, House of Representatives*. Butts, K.H. 25 June 2008. Available at: <http://globalwarming.house.gov/tools/2q08materials/files/0070.pdf>.

Butts (2007): *Climate Change and Security*. Butts, K.H. Testimony to the House Committee on Science and Technology, Subcommittee on Investigations and Oversight. September 27, 2007. Available at: http://democrats.science.house.gov/Media/File/Commdocs/hearings/2007/oversight/27sept/butts_testimony.pdf.

Carlson et al. (2008): "Rapid Early Holocene Deglaciation of the Laurentide ice sheet." Carlson, A.E., A.N. Le Grande, D.W. Oppo, R.E. Came, G.A. Schmidt, F.S. Anslow, J.M. Licciardi & E.A. Obbink. *Nature Geoscience*, 1: 620–624 (2008). Available at: <http://www.nature.com/ngeo/journal/v1/n9/abs/ngeo285.html>

CCSP (2009): *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region*. Synthesis and Assessment Product 4.1. Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Available at: <http://www.climatescience.gov/Library/sap/sap4-1/default.php>.

CCSP (2008a): *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I*. March 2008. Synthesis and Assessment Product 4.7 Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Available at: <http://www.climatescience.gov/Library/sap/sap4-7/>.

CCSP (2008b): *Effects of Climate Change on Energy Production and Use in the United States*. February 2008. Synthesis and Assessment Product 4.5 Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Available at: <http://www.climatescience.gov/Library/sap/sap4-5/final-report/sap4-5-final-all.pdf>.

CCSP (2008c): The effects of climate change on agriculture, land resources, water resources, and biodiversity. Climate Change Science Program, Synthesis and Assessment Product 3.3. Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. July 2008. Available at: <http://www.climatescience.gov/Library/sap/sap4-3/default.php>.

CCSP (2008d): *Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems, Executive Summary*. Climate Change Science Program, Synthesis and Assessment Product 4.6. Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. July 2008. Available at: <http://www.climatescience.gov/Library/sap/sap4-6/default.php>.

CCSP (2008e): *Weather and Climate Extremes in a Changing Climate, Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands*. Climate Change Science Program, Synthesis and Assessment Product 3.3. June 2008. Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Available at: <http://www.climatescience.gov/Library/sap/sap3-3/final-report/sap3-3-final-all.pdf>.

CNA (2009): *Powering America's Defense: Energy and the Risks to National Security*. Center for Naval Analyses. May 2009. Available at: <http://www.cna.org/nationalsecurity/energy/>.

CNA (2007): *National Security and the Threat of Climate Change*. Center for Naval Analyses. 2007. Available at: <http://securityandclimate.cna.org/>.

CNAS (2009): *Climate Change War Game: Major Findings and Background*. S. Burk. Center for a New American Security, June 2009. Available at: <http://www.cnas.org/node/964>.

Cornejo (2007): *Ecuador Case Study: Climate Change Impact on Fisheries*. P. Cornejo. 2007. Human Development Report 2007/2008, Fighting climate change: Human solidarity in a divided world. Human Development Report Office. Occasional Paper. UNDP. Available at: http://hdr.undp.org/en/reports/global/hdr2007-2008/papers/cornejo_pilar.pdf.

CSIS & CNAS (2007): *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*. Campbell, K.M., J. Guleidge, J.R. McNeill, J. Podesta, P. Ogden, L. Fuerth, R.J. Woolsey, A.T.J. Lennon, J. Smith, R. Weitz, and D. Mix. November 2007. Center for Strategic and International Studies: Washington, DC. Available at: http://www.csis.org/component?option=com_csis_pubs/task,view/id,4154/type,1.

DoD (2009): *2010 QDR Terms of Reference Fact Sheet*. April 27, 2009. Department of Defense. Available at: <http://www.defenselink.mil/news/d20090429qdr.pdf>.

Dumaine (2009): "Security in a World in which 'There is No More Normal.'" Dumaine, C. Presentation at *Climate Change and Security at Copenhagen, New Thinking on the Atlantic Contribution to Success*, 17 March 2009. Institute for Environmental Security, Brooking Institute, Washington DC. Available at: <http://www.envirosecurity.org/CCSC/Dumaine.pdf>.

Dupont (2008): *The Strategic Implications of Climate Change*. A. Dupont. *Survival*, 50(3) June–July 2008, 29–54. Available at: <http://www.informaworld.com/smpp/content~db=all?content=10.1080/00396330802173107>.

EC (2008): *Climate Change and International Security*. Paper from the High Representative and European Commission to the European Council. High Representative and European Commission. 2008. S113/08, March 14, 2008. Available at: http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressdata/EN/reports/99387.pdf.

Ebi (2007): *Regional Impacts of Climate Change: Four Case Studies in the United States*. K.L. Ebi, G.A. Meehl, D. Bachelet, et al., R.R. Twilley, D.F. Boesch, et al. Prepared for the Pew Center on Global Climate Change. December 2007. Available at: http://www.pewclimate.org/regional_impacts.

EU (2008a): *Report on the Implementation of the European Security Strategy, Providing Security in a Changing World*. Brussels, 11 December 2008, S407/08. Available at: http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressdata/EN/reports/104630.pdf.

EU (2008b): *The European Union and the Arctic Region*. Communication from the Commission to the European Parliament and the Council. Brussels, 20 November 2008, COM (2008) 763 final. Commission of the European Communities. Available at: http://www.ec.europa.eu/external_relations/arctic_region/docs/com_08_763_en.pdf.

FAO (2008): *The State of Food Insecurity in the World 2008: High Food Prices and Food Security – Threats and Opportunities*. Food and Agriculture Organization of the United Nations. December 2008. Available at: <http://www.fao.org/SOF/sofi/>.

FAO (2007): *Climate Change and Food Security: A Framework Document*. Interdepartmental Working Group (IDWG) on Climate Change, Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/clim/index_en.htm.

FfP (2009): *The Failed States Index 2009*. July 2009. Fund for Peace. Available at: http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=99&Itemid=140.

Fingar (2008): "National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030." Fingar, T. *Statement for the Record of Dr. Thomas Fingar, Deputy Director of National Intelligence for Analysis and Chairman of the National Intelligence Council Before the Permanent Select Committee on Intelligence and the Select Committee on Energy Independence and Global Warming, House of Representatives*. 25 June 2008. Available at: <http://globalwarming.house.gov/tools/2q08materials/files/0069.pdf>.

Foreign Policy As "Russia plans military and economic development in Arctic." March 31, 2009. *The Arctic, the World Affairs Blog Network*. Available at: <http://arctic.foreignpolicyblogs.com/2009/03/31/russiandevelopment-plans-in-arctic/>.

Freimuth et al. (2007): *Climate Change: A New Threat to Middle East Security*. Freimuth, L., G. Bromberg, M. Mehary, and N. Al Khateeb. December 2007. EcoPeace/Friends of the Earth Middle East. Israel. Available at: <http://www.foeme.org/publications.php?ind=78>.

Gaffney (2008): *Testimony of Paul G. Gaffney II (Vice Admiral, U.S. Navy (Ret.)) President, Monmouth University*. Gaffney, P.G. II. Before a Joint Hearing of the House Permanent Select Committee on Intelligence, Subcommittee on Intelligence Community Management, and House Select Committee on Energy Independence and Global Warming, U.S. House of Representatives, Washington, DC. June 23, 2008. Available at: <http://globalwarming.house.gov/tools/2q08materials/files/0066.pdf>.

Garnaut (2008): *Garnaut Climate Change Review*. Commonwealth of Australia. 2008. Available at: http://www.gci.org.uk/Garnault/Climate_Change_Review_Draft_Report_040708.pdf.

German Marshall Fund (2009): "Arctic event highlights climate change impact, resource battle." *Roundtable discussion sponsored by the German Marshall Fund of the United States and Ecologic Institute*, Germany, 29 April 2009, Washington DC. Available at: http://www.gmfus.org/event/detail.cfm?id=567&parent_type=E.

Gleick (2006): "The Implications of Global Climatic Changes for International Security." Gleick, P.H. 2006. *Testimony of Dr. Peter H. Gleick to the United States Congress*, Committee on Government Reform. Subcommittee on National Security, Emerging Threats, and International Relations Hearing on Energy as a Weapon: Implications for U.S. Security. May 16, 2006. Available at: <http://www.pacinst.org/publications/testimony/>.

Goodman (2009): *Climate Change and Energy: 21ST Century Challenges to National Security*. S. Goodman, General Counsel, CNA, Executive Director of CNA's Military Advisory Board, and former Deputy under Secretary of Defense for Environmental Security. Closing Keynote Address before the National Defense Industrial Association, Environment, Energy & Sustainability Symposium and Exhibition, Denver, Colorado, May 5, 2009. Available at: http://www.cna.org/documents/CNA_09_Goodman_Remarks_NDIA_As_Given.pdf.

Hendrix & Glaser (2007): "Trends and Triggers: Climate Change and Civil Conflict in Sub-Saharan Africa." Hendrix, C.S. and Glaser, S.M. 2007. In *Proc. Human Security and Climate Change*, 21 – 23 June, near Oslo. Global Environmental Change and Human Security Program. Available at: http://www.gechs.org/downloads/holmen/Hendrix_Glaser.pdf.

Herman & Treverton (2009): The Political Consequences of Climate Change. P.F. Herman Jr. and F. Treverton. *Survival* 5(2), April–May 2009, pp. 137–148. Available at: <http://www.iiss.org/publications/survival/survival-2009/year-2009-issue-2/the-political-consequences-of-climate-change/>.

Hewitt et al. (2009): "The Peace and Conflict Instability Ledger: Ranking States on Future Risk." In J. Hewitt, J. Wilkenfeld, and T.R. Gurr, *Peace and Conflict 2008*. University of Maryland. Available at: <http://www.cidcm.umd.edu/pc/>.

Holtsmark (2009): "Towards cooperation or confrontation? Security in the High North." S.G. Holtsmark. NATO Research paper, NATO Defence College, No. 45, February 2009. Available at: <http://www.isn.ethz.ch/isn/Digital-Library/Publications/Detail/?ots591=0C54E3B3-1E9C-BE1E-2C24-A6A8C7060233&lng=en&id=97586>.

Huq & Ayers (2007): *Critical List: The 100 Nations Most Vulnerable to Climate Change*. Huq, S. and J. Ayers. November 2007a. International Institute for Environment and Development. Available at: <http://www.iied.org/pubs/pdfs/17022IIED.pdf>.

ICF (2007): *The Potential Impacts of Global Sea Level Rise on Transportation Infrastructure: Phase 1 - Final Report: the District of Columbia, Maryland, North Carolina and Virginia*. 2007, ICF International. Available at: <http://www.bv.transports.gouv.qc.ca/mono/0965210.pdf>.

IISD (2007): *Climate Change and Foreign Policy, An exploration of options for greater integration*. International Institute for Sustainable Development. 2007. Canada. Available at: <http://www.iisd.org/publications/pub.aspx?pno=843>.

IWMI (2007): *Comprehensive Assessment of Water Management in Agriculture*. 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute. Available at: http://www.iwmi.cgiar.org/Assessment/files_new/synthesis/Summary_SynthesisBook.pdf.

Johnson (2007): *Global Climate Change: National Security Implications*. Johnson, D.V. II. 2007. Colloquium Brief. U.S. Army War College, Strategic Studies Institute. Available at: <http://www.strategicstudiesinstitute.army.mil/pubs/display.cfm?pubID=862>.

Jordan (2003): *Multilateralism in North East Asia*. Jordan, M.J. February 2003. Naval War College. Available at: <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA415621&Location=U2&doc=GetTRDoc.pdf>.

Kelman (2006): "Island Security and Disaster Diplomacy in the Context of Climate Change." Kelman, I. 2006. *Les Cahiers de la Sécurité*, vol. 63, pp. 61-94. Available at: <http://www.disasterdiplomacy.org/kelman2006cce.pdf>.

Lane (2008): *National Security Implications of Climate Change*. Hearing of The Permanent Select Committee on Intelligence and the House Select Committee on Energy Independence and Global Warming By Lee Lane, Resident Fellow, American Enterprise Institute. June 25, 2008. Available at: http://www.fas.org/irp/congress/2008_hr/062508lane.pdf.

Lennon (2007): "The Foreign Policy and National Security Implications of Global Climate Change." Lennon, A.T.J. September 2007. *Statement by Alexander T. J. Lennon, Ph.D.* (Fellow, International Security Policy & Editor in Chief, The Washington Quarterly) before the Subcommittee on Investigations and Oversight, House Committee on Science and Technology. September 27, 2007. Available at: http://democrats.science.house.gov/Media/File/Commdocs/hearings/2007/oversight/27sept/lennon_testimony.pdf.

Levy (2008): *Assessment of Select Climate Change Impacts on U.S. National Security*. M.A. Levy, B. Anderson, M. Brickman, C. Cromer, B. Falk, B. Fekete2, P. Green, M. Jaiteh, R. Lammers, V. Mara, K. MacManus, S. Metzler, Maria Muñiz, Thomas Parris, Randy Pullen, C. Thorkelson, C. Vorosmarty, W. Wollheim, X. Xing, G. Yetman. Center for International Earth Science Information Network, Columbia University. Working Paper, 1 July 2008. Available at: http://www.ciesin.columbia.edu/documents/Climate_Security_CIESIN_July_2008_v1_0.ed.pdf.

Lowry Institute (2006): *Heating up the Planet, Climate Change and Security*. Dupont, A. and G. Pearman. 2006. Paper 12. Lowry Institute for International Policy: Australia. Available at: <http://www.lowyinstitute.org/Publication.asp?pid=391>.

Lynch (2009): *Environmental Challenges and Global Security*. LTC Steve Lynch, Joint Staff J-5. 2009. Unclassified briefing. Available at: <http://www.pecad.fas.usda.gov/pdfs/2009/Joint%20Chiefs,%20DoD,%20Colonel%20Stephen%20J.%20Lynch.pdf>.

Mabey (2008): *Delivering Climate Security, International Security Responses to a Climate Changed World*. N. Mabey, April 2008, Whitehall Paper 69, Royal United Services Institute. Available at: http://www.rusi.org/go.php?structureID=issues_whitehall.

Mann (2009): "Defining dangerous anthropogenic interference." *PNAS*, March 17, 2009, 106(11): 4065–4066. Available at: <http://www.pnas.org/content/early/2009/03/09/0901303106.full.pdf>

Maybee (2008): *National Security and Global Climate Change*. Maybee, S.C. (Commander, USN) Available at: http://www.ndu.edu/inss/Press/jfq_pages/editions/i49/26.pdf.

Michel & Pandya (2009): *Troubled Waters, Climate Change, Hydropolitics, and Transboundary Resources*. Michel, D. and A. Pandya (Eds.). The Henry L. Stimson Center, 2009. Available at: http://www.stimson.org/rv/pdf/Troubled_Waters/Troubled_Waters-Complete.pdf.

NASA (2006): *Greenland Ice Sheet on a Downward Slide*. Goddard Space Flight Center. Maryland: NASA. Available at: http://www.nasa.gov/centers/goddard/news/topstory/2006/green_land_slide.html.

NATO (2009): *Declaration on Alliance Security*. North Atlantic Treaty Organization, 04 Apr. 2009. Available at: http://www.nato.int/cps/en/natolive/news_52838.htm.

Navy (2007): *Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations*. 2nd Symposium. July 10–12 2007, U.S. Navy Memorial & Naval Heritage College: Washington, DC. Available at: <http://www.star.nesdis.noaa.gov/star/IceSymposium.php>.

Navy (2001): *Proceedings of Naval Operations in an Ice Free Arctic Symposium*. April 2001, Office of Naval Research. Available at: <http://www.natice.noaa.gov/icefree/FinalArcticReport.pdf>.

NDAA (2008): *Public Law 110-181 - FY 2008 National Defense Authorization Act (NDAA)*, January 28, 2008. Available at: <https://acc.dau.mil/CommunityBrowser.aspx?id=135658>.

NDU (2008): *Unfrozen Treasures – National Security, Climate Change and the Arctic Frontier*. Conference Report from seminar in the Transforming National Security Seminar Series, May 13 – 14. National Defense University: Washington, DC. Available at: http://www.ndu.edu/CTNSP/NCW_course.htm.

Niasse (2005): Climate-Induced Water Conflict Risks in West Africa: Recognizing and Coping with Increasing Climate Impacts on Shared Watercourses." M. Niasse. *Proc. Human Security and Climate Change, An International Workshop*, Holmen Fjord Hotel, Asker, near Oslo, 21–23 June 2005.

NIC (2008): *Global Trends 2025, A Transformed World*. NIC 2008-003. National Intelligence Council. November 2008. Washington: DC. Available at: www.dni.gov/nic/NIC_2025_project.html.

NRC (2009): *Informing Decisions in a Changing Climate*. Panel on Strategies and Methods for Climate-Related Decision Support, Committee on the Human Dimensions of Climate Change, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. Available at: http://www.nap.edu/catalog.php?record_id=12626.

NRC (2008): Potential Impacts of Climate Change on U.S. Transportation. Transportation Research Board Special Report 290, Committee on Climate Change and U.S. Transportation, Transportation Research Board Division on Earth and Life Studies, National Research Council. Available at: <http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>.

NTSC (2008): *Scientific Assessment of the Effects of Global Change on the United States*. National Science and Technology Council, 2008. Available at: <http://www.climatescience.gov/Library/scientificassessment/Scientific-AssessmentFINAL.pdf>.

Pai (2008): "Climate Change and National Security: Preparing India for New Conflict Scenarios." Nitin Pai. *The Indian National Interest Policy Brief*, No. 1 April 2008. Available at: <http://nationalinterest.in/wp-content/uploads/2008/04/inipolicybrief-no1-climatechangeandnationalsecurity-nitinpaisapril2008.pdf>.

Paskal (2009): *The Vulnerability of Energy Infrastructure to Environmental Change*. Cleo Paskal, April 2009, A Chatham House Briefing Paper. Available at: <http://www.chathamhouse.org.uk/publications/papers/view/-/id/737/>.

PRB (2008): World Population Highlights, Key Findings from PRB's 2008 World Population Data Sheet. Population Bulletin, 83(3), September 2008. Population Reference Bureau, Washington, DC. Available at: <http://www.prb.org/pdf08/63.3highlights.pdf>.

Price-Smith (2007): "On Climate Change and Infectious Disease: Implications for Political Destabilization and Conflict." Price-Smith, A. *Testimony to the House Committee on Science and Technology*, Subcommittee on Investigations and Oversight. September 27, 2007. Available at: http://democrats.science.house.gov/Media/File/Commdocs/hearings/2007/oversight/27sept/price_smith_testimony.pdf.

Purdy (2008): *Climate Change and Security: A Canadian Perspective*. Centre of International Relations, University of British Columbia. 2008. Vancouver, BC, Canada. Available at: <http://www.cir.ubc.ca/#/climate-change/4532641878>.

Reid et al. (2007): *Counting the cost of climate change in Namibia*. H. Reid, J. MacGregor, L. Sahlén, and J. Stage. Sustainable Development Opinion, December 2007. IIED. Available at: file:///localhost/C:/Documents%20and%20Settings/youngb/My%20Documents/SharePoint%20Dr_afts/Counting%20the%20cost%20of%20climate%20change%20in%20Namibia.

Reveron (2007): *Africa Command: Security and Stability, not Oil or Confrontation*. Reveron, D. CENSA-Notes. February 2007. Available at: http://www.censa.net/AfricaCommand_DReveron.pdf.

Richardson et al. (2009): Synthesis Report from Climate Change, Global Risks, Challenges and Decisions. Richardson, K., W. Steffen, H.J. Schellnhuber, J. Alcamo, T. Barker, D.M. Kammen, R. Leeman, D. Liverman, M. Munasinghe, B. Osman-Elasha, N. Stern, O. Wæver. International Alliance of Research Universities. June 2009. Available at: <http://climatecongress.ku.dk/pdf/synthesisreport>.

Rudd (2008): *First National Security Statement to the Australian parliament*. Hon. Kevin Rudd MP, 4 December 2008. Available at: http://www.pm.gov.au/media/Speech/2008/speech_0659.cfm.

Sandia (2003): *Global Climate Change and International Security*. Karas, T.H. November 2003. Sandia Report SAND2003-4114. Sandia National Laboratories: Albuquerque, New Mexico. Available at: <http://www.prod.sandia.gov/cgi-bin/techlib/access-control.pl/2003/034114.pdf>.

Schubert et al. (2008): *Climate Change as a Security Risk*. Schubert, R., H. J. Schellnhuber, N. Buchmann, A. Epiney, R. Grießhammer, M. Kulessa, D. Messner, S. Rahmstorf, and J. Schmid. January 2008. German Advisory Council on Global Change. Earthscan: London and Sterling, VA. Available at: http://www.wbgu.de/wbgu_jg2007_engl.html.

SERDP (2009): *Effects of Near-Term Sea Level Rise on Coastal Infrastructure*. Strategic Environmental Research and Development Program (SI-1700). Accessed 5/21/09. Available at: <http://www.serdp.org/Research/SI-1700-FS.cfm>.

Sigler (2008): *Future Force Planning for the Middle East*. Rear Admiral John F. Sigler (Ret.), Journal of International Security Affairs, spring 2009 - Number 16. Available at: <http://www.securityaffairs.org/issues/2009/16/sigler.php>.

Smith & Vivekananda (2007): *A Climate of Conflict, The links between climate change, peace and war*. Smith, D. and J. Vivekananda. November 2007. International Alert. London, U.K. Available at: http://www.international-alert.org/pdf/A_Climate_Of_Conflict.pdf.

Solana (2008): *Climate Change and Security: Follow-up recommendations by EUHR Solana*. Javier Solana, the High Representative, European Union, 18 December 2008, Brussels. Available at: http://www.europa.eu/articles/fr/article_8382_fr.htm.

Spears (2009): "China and the Arctic: The Awakening Snow Dragon." Spears, K.J. *China Brief*, IX (6), March 19, 2009. The Jamestown Foundation. Available at: http://www.jamestown.org/uploads/media/cb_009_6_01.pdf.

Tannehill (2008): *Forecasting Instability Indicators in the Horn of Africa*. March 2008. Master's Thesis. Air Force Institute of Technology, Wright-Patterson AFB, OH. Available at: <http://www.stormingmedia.us/19/1960/A196084.html>.

Truly (2007): "National Security and the Threat of Climate Change." Vice Admiral Richard Truly, USN (Ret.) Testimony before the Committee on Foreign Relations, U.S. Senate. May 9, 2007. Available at: <http://foreign.senate.gov/testimony/2007/TrulyTestimony070509.pdf>.

Uyigue (2009): *The Changing Climate and the Niger Delta*. Uyigue, E. Community Research and Development Centre, Nigeria. Available at: <http://www.climatefrontlines.org/sites/default/files/The%20Changing%20Climate%20and%20the%20Niger%20Delta.pdf>.

UK (2008): *The National Security Strategy of the United Kingdom, Security in an interdependent world*. Presented to Parliament by the Prime Minister, by command of Her Majesty, Cm7291, March 2008. Available at: http://interactive.cabinetoffice.gov.uk/documents/security/national_security_strategy.pdf.

UN (2008): *Security and climate change*. Sixty-third session, Agenda item 107, Follow-up to the outcome of the Millennium Summit. UN General Assembly. United Nations, A/63/L.8. 27 October 2008. Available at: <http://www.undemocracy.com/A-63-L.8.pdf>.

UNEP (2009): *Climate in Peril, A popular guide to the latest IPCC reports*. United Nations Environment Programme. June 2009. GRID-Arendal: Norway. Available at: http://www.grida.no/_res/site/file/publications/ClimateInPeril.pdf.

UNEP (2007): *Environmental Degradation Triggering Tensions and Conflict in Sudan*. UN Environment Programme. 22 June 2007. Available at: <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=512&ArticleID=5621&l=en>.

UNEP (2005): *Environment and Security: Transforming risks into cooperation - Central Asia - Ferghana / Osh / Khujand area*. UNEP, 2005. Available at: http://www.grida.no/_res/site/file/publications/envsec/ferghana-report-eng.pdf.

UNESCO (2009): *Water in a Changing World*. The United Nations World Water Development Report 3. The United Nations Educational, Scientific and Cultural Organization (UNESCO): London, UK. 2009. Available at: http://webworld.unesco.org/water/wwap/wwdr/wwdr3/pdf/WWDR3_Water_in_a_Changing_World.pdf.

USAID (2007): *Adapting to Climate Variability and Change, A Guidebook Manual for Development Planning*. U.S. Agency for International Development. August 2007. Available at: http://www.usaid.gov/our_work/environment/climate/docs/reports/cc_vamanual.pdf.

USAID (2002): *U.S.-India Cooperation on Global Climate Change: A Compendium of Activities*. Eighth Conference of the Parties (COP 8) to the United Nations Convention on Climate Change, New Delhi, India 23 October – 1 November 2002. Available at: <http://www.usaid.gov/in/Pdfs/compendium.pdf>.

USARC (2003): *Climate Change, Permafrost, and Impacts on Civil Infrastructure*. U.S. Arctic Research Commission, Permafrost Task Force Report. December 2003. Available at: <http://www.arctic.gov/files/PermafrostForWeb.pdf>.

USJFCOM (2007): *Joint Operating Environment, Trends and Challenges for the Future Joint Force through 2030*. U.S. Joint Forces Command. December 2007. Available at: http://www.au.af.mil/au/awc/awcgate/jfcom/joe_dec2007.pdf.

USGCRP (2009): *Global Climate Change Impacts in the United States. A State of Knowledge Report from the U.S. Global Change Research Program*. June 2009. Cambridge University Press. Available at: <http://globalchange.gov/publications/reports/scientific-assessments/us-impacts>.

USGCRP (2000): *U.S. National Assessment of the Potential Consequences of Climate Variability and Change*. First U.S. National Assessment (2000). U.S. Global Change Research Program. Available at: <http://globalchange.gov/publications/reports/scientific-assessments/first-national-assessment>.

Warner (2009): *In Search of Shelter, Mapping the Effects of Climate Change on Human Migration and Displacement*. May 2009. K. Warner, C. Ehrhart, A. de Sherbinin, S. Adamo, and T. Chai-Onn. UN, CARE International, and Center for International Earth Science Information Network at the Earth Institute of Columbia University. May 2009. Available at: http://www.care.org/getinvolved/advocacy/pdfs/Migration_Report.pdf?s_src=170920500000&s_usbsrc=.

White House (2009): *Arctic Region Policy*. National Security Presidential Directive (NSPD)-66 / Homeland Security Presidential Directive (HSPD)-25. January 9, 2009. Available at: <http://www.fas.org/irp/offdocs/nspd/nspd-66.htm>.

Wolf (2007): *A Long Term View of Water and Security: International Waters, National Issues, and Regional Tensions*. A.T. Wolf. A Report to the: German Advisory Council on Global Change (WBGU). Berlin 2007. A Report to the: German Advisory Council on Global Change (WBGU). Available at: http://www.wbgu.de/wbgu_jg2007_ex08.pdf.

Woodrow Wilson (2004): *The Security Implications of Climate Change for the UN System*. Purvis, N. and J. Busby. 2004. Policy Brief, Environmental Change and Security Program Report, Issue 10. Woodrow Wilson International Center for Scholars. Available at: http://www.wilsoncenter.org/topics/pubs/ecspr10_unf-purbus.pdf.

Woolsey (2007): *Testimony before the House of Representatives*. R. James Woolsey, Committee on Science and Technology, Subcommittee on Investigations and Oversight, "The National Security Implications of Climate Change." September 27, 2007. Available at: http://democrats.science.house.gov/Media/File/Commdocs/hearings/2007/oversight/27sept/woolsey_testimony.pdf.

Appendix A: Chronology of Climate Change and Security Events

This chronology provides a timeline for major assessments, reports, conferences, and congressional hearings, and statements regarding the security implications of climate change. We have attempted to identify all of the relevant Congressional hearings and proposed legislation for 2009, but entries for 2008 and 2007 are restricted to particularly important hearings, although all relevant legislative proposals are captured. Coverage of important other kinds of events becomes similarly less comprehensive for each previous year.

2009		Activity / Event	Type
Jun	6/3/09	The United Nations General Assembly unanimously adopts a draft resolution on follow-up to the outcome of the Millennium Summit titled " Climate change and its possible security implications " that includes a request for the Secretary-General to submit a comprehensive report to the General Assembly at its sixty-fourth session on the possible security implications of climate change, based on the views of the Member States and relevant regional and international organizations.	Draft resolution
Mar	3/30-09 – 3/31/09	In response to a request from Congress, the National Academies have initiated a suite of studies called Summit on America's Climate Choices, Earth's climate is changing. How will we respond? This summit will begin a process of open dialog among key stakeholders and decision makers, outline the key questions that need to be answered to move ahead, help inform and frame the context of the America's Climate Choices studies, and set the stage for national action on climate change.	Summit
Mar	3/27/09	The Russian Security Council releases details of its Arctic policy up to 2020 and beyond (Foreign Policy Association 2009). ⁴⁹	Policy
Mar	3/25/09	House Committee on Foreign Affairs hearing on Climate Change and the Arctic: New Frontiers of National Security . Testimony from Dr. Scott Borgerson, Dr. Robert Corell, and Mr. Mead Treadwell.	Hearing
Mar	3/20/09	Energy and Commerce Subcommittee hearing on "The Climate Crisis: National Security, Public Health, and Economic Threats." Testimony from Professor Daniel Schrag , and Dr. Patrick Michaels .	Hearing
Feb	2/25/09	The International Institute for Strategic Studies, Transatlantic Dialogue on Climate Change and Security . Funded by the European Commission, to provide a forum for policy makers to explore the ways in which a warming global climate will affect global and regional security.	Meeting
Feb	2/24/09	In the run up to the NATO Summit in Strasbourg-Kehl in April 2009, NATO Public Diplomacy Division and Carnegie Europe launched a discussion on " The Next Generation of Security Threats – Reprogramming NATO? " and the reprogramming of NATO.	Discussion
Feb	2/19/09	Woodrow Wilson International Center for Scholars hosts a Climate Security Roundtable: U.S. and EU Research and Policy .	Meeting
Feb	2/12/09	House Committee on Energy and Commerce hearing on The Climate Crisis: National Security, Public Health, and Economic Threats . Testimony from Dr. Frank Ackerman , Dr. Kristie Ebi , Gen. Gordon Sullivan, Prof. Daniel Schrag , Dr. Patrick J. Michaels , and R. James Woolsey .	Hearing
Feb	2/12/09	Senate Select Committee on Intelligence hearing Testimony from Blair, Annual Threat Assessment of the Intelligence Community addresses environmental security and the need to assess climate change impacts.	Hearing
Jan	1/29/09	NATO Secretary General Jaap de Hoop Scheffer addresses Arctic Climate Change, Security .	Seminar
Jan	1/20/09	Security and Climate Change in Africa , conference to discuss the connection between conflict and climate change on the African continent, with representatives from UN, African Union, EC, major international NGOs, and other organizations.	Conference

⁴⁹ The original document, "[The fundamentals of Russian state policy in the Arctic up to 2020 and beyond](#)" is available in Russian at: <http://www.scrf.gov.ru/news/421.html>.

	1/9/09	White House National Security Presidential Directive and Homeland Security Presidential Directive on Arctic Region Policy. Addresses the effects of climate change and increasing human activity in the Arctic region.	Directive
2008			
Dec	12/18/08	The EU High Representative provides follow-up recommendations to the High Representative and Commission report on Climate Change and International Security.	Report
Nov	11/30/08	The UN Environment Programme, with the EU Member States Defense Environment Network, the US Department of Defense, the Institute for Environmental Security, the US Environmental Protection Agency, the Organization for Security and Cooperation in Europe, the Institute for Defense Analysis, and the Environment and Security Initiative sponsored The Importance of Military Organizations in Protecting the Climate: 2008 .	Workshop
		The National Intelligence Council, Global Trends 2025: A Transformed World identifies how quickly climate change occurs and the locations where its impact is most pronounced as key uncertainties.	Study
Oct	10/30/08	Department of Defense sponsored an educationally focused colloquium, An Introduction to Implications of Climate Change for Planning for Defense and National Security Planning.	Colloquium
	10/27/08 – 10/30/09	NGA GEOINT 2008, included a panel discussion on what makes climate change a national security issue and why.	Panel
Jul	7/28/08 – 7/30/08	Center for a New American Security, Cloud and Climate Change war game to study and highlight the national security threats posed by global warming.	War game
	6/23/08 – 6/25/08	Joint Hearing of the House Permanent Select Committee on Intelligence, Subcommittee on Intelligence Community Management and House Select Committee on Energy Independence and Global Warming, U.S. House of Representatives. Testimony from Rt. Hon. Margaret Beckett , Dr. Kent Hughes Butts , Dr. Thomas Fingar , Paul G. Gaffney II , Lee Lane , Marlo Lewis .	Hearing
Jun	6/13/08	Speaking at the UN Association-UK in London, United Kingdom, UN Secretary-General Ban Ki-moon Highlights Climate Change as Key Threat . U.S. and Canadian Coast Guard Chiefs discuss growing Arctic mission .	Speech
		National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030, prepared by the National Intelligence Council. (Classified)	NIA
		Council on Foreign Relations, Confronting Climate Change: A Strategy for U.S. Foreign Policy .	Study
		The Strategic Implications of Climate Change , by Dupont is Michael Hintz Professor of International Security and Director of the Centre for International Security Studies at the University of Sydney.	Article
	5/13/08 – 5/14/08	National Defense University and Forces Transformation and Resources Seminar, Unfrozen Treasures- National Security, Climate Change and the Arctic Frontier .	Seminar
	5/14/08	A bipartisan group of current and former lawmakers, military officers and security analysts has issued a new report on U.S. security policy, A New American Arsenal , -- intended to influence the next administration -- calling for a stronger emphasis on energy security and climate change as critical national security issues.	Report
May	5/8/08 – 5/10/08	Influence of Climate Change on the Changing Arctic and Subarctic Conditions . The NATO - Russia Advanced Research Workshop will be held in Liège, Belgium, From May 8th through 10th 2008 in association with the 40th International Liège Colloquium on Ocean Dynamics.	Workshop
		Climate Change and Security, Challenges for German Development Corporation , on behalf of the German Federal Ministry for Development and Cooperation.	Study
		Publication of proceedings from the March 2007 National Security Implications of Climate Change colloquium [see below] held by the Army War College & Triangle Research Institute for Security Studies.	Papers

Apr	4/24/08 – 4/25/08	Conflict Prevention & Climate Change organized by the Madariaga European Foundation and others in close cooperation with the General Secretariat of the Council of the European Union, the European Commission and the European Peacebuilding Liaison Office (EPLO).	Workshop
	4/14/08	Inside the Navy, Coast Guard continues to push for new Polar policy, new icebreakers .	Article
		Climate Change and Security, Challenges for German Development Corporation , explores sectoral and regional connections, effects and the potentials for conflict and security risks, providing proposals for actions.	Study
		Royal United Services Institute for Defence Studies, Climate Change and Security in Southern Asia: Understanding the National Security Implications .	Article
Mar		Assessing the security implications of climate change for West Africa, Country case studies of Ghana and Burkina Faso , study conducted by IISD, funded by the Ministry of Foreign Affairs, Government of Denmark.	Study
	3/14/08	Climate Change and International Security , paper from the High Representative and the European Commission to the European Council.	Report
	3/6/08	Global Climate Change and National Security: The Science and the Impact , hosted by the Potomac Institute for Policy Studies.	Seminar
		USCCP Impacts of Climate Variability and Change on Transportation Systems and Infrastructure -- Gulf Coast Study . Final Report of Synthesis and Assessment Product 4.7. (Includes sea level rise Impacts on New Orleans Naval Air Station Joint Reserve Base, military operations at civilian airports.)	Study
		NRC, Potential Impacts of Climate Change on U.S. Transportation . (US Army Corp of Engineers among groups funding of this work.)	Study
		Foreign Affairs, Arctic Meltdown, The Economic and Security Implications of Global Warming .	Article
Feb		Indian National Interest Policy Brief, Climate Change and National Security: Preparing India for New Conflict Scenarios .	Report
		The National Security Strategy of the United Kingdom, Security in an Interdependent World discusses climate change as one of an interconnected set of factors that threaten national security.	Strategy
	2/26/08-2/29/08	Climate change, water and food security , and climate change and disaster risk management conferences, hosted by FAO .	Conference
	2/18/08	Conflict Risks, Human Security and Climate Change , hosted by the Swedish International Development Cooperation Agency and International Alert. New version of a Climate of Conflict released.	Forum Report
Jan	2/16/08	Palau (small Pacific island state) seeks Security Council protection on climate change.	Article
	2/14/08	Podesta and Ogden, Pentagon faces a battle on climate change .	Article
	1/31/08	Brookings Institute event, Climate Change: The Next Global Security Threat . Featured speaker Johan Eliasch, UK Prime Minister's Special Representative for Deforestation and Clean Energy.	Presentation
Jan	1/30/08-1/31/08	Talks convened by President Bush to further shared objectives of reducing greenhouse gas emissions, increasing energy security and efficiency, and sustaining economic growth; and to help advance the negotiations under the UNFCCC. Australia, Brazil, Britain, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa, South Korea and the United Nations are expected to attend.	Policy
	1/21/08	Coast Guard announces plans for the summer to test how ships and aircraft operate in the Arctic environment. Cmd. Adm. Allen argues it is "time to have a national discussion about the Arctic..."	Article
	1/16/08-1/18/08	Climate Change: Science and Solutions , 8 th National Conference on Science, Policy, and the Environment; National Council for Science and Environment, DC.	Conference

	1/11/08	United Nations meteorological agency is to present an updated strategy for tracking severe weather and changes to the Earth's climate with dozens of new satellites at a meeting of top officials of international space agencies.	Press story
	1/03/08	Whelan (AFRICOM) on climate change.	Interview
	1/02/08	California sues the EPA for denying its first-in-the-nation greenhouse gas limits on cars, trucks and SUVs, challenging the Bush administration's conclusion that states have no business setting emission standards. Other states are expected to join.	Policy
		Climate Change as a Security Risk , German Advisory Council on Global Change.	Report
		An Uncertain Future, Law Enforcement, National Security and Climate Change , Oxford Research Group, UK.	Paper

	2007	Activity / Event	Type
Dec	12/28/07	H.R. 1585: 2008 Defense Authorization Bill vetoed by President Bush.	Legislation
	12/19/07	Energy Independence and Security Act of 2007 signed into law. Intended to help reduce America's dependence on oil by: <ul style="list-style-type: none"> - Increasing supply of alternative fuel sources by setting a mandatory Renewable Fuel Standard (RFS) requiring fuel producers to use at least 36 billion gallons of biofuel in 2022, - Reducing U.S. demand for oil by setting a national fuel economy standard of 35 miles per gallon by 2020 (an increase of 40%). 	Legislation
	12/18/07	Climate Change, Security and Sustainable Development , Report of the Conference "From Bali to Poznan – New Issues, New Challenges."	Conference
	12/14/07	H.R. 1585: 2008 Defense Authorization Bill passed House and Senate, and differences resolved. Requires "all future national security strategies and the next quadrennial defense review to include guidance on the effect of climate change on DoD facilities, capabilities, and missions, including preparedness for natural disasters from extreme weather events."	Legislation
	12/12/07	Ex-Cmdr.: Climate changes threatens VA bases.	Article
	12/11/07 – 12/13/07	Regional Security and Climate Change conference sponsored by the Long Range Analysis Unit of the National Intelligence Council and held at the US Naval Postgraduate School.	Conference
	12/07/07	Joint Operating Environment, Trends and Challenges for the Future Joint Force Through 2030 , December 2007, addresses climate change for the first time.	Study
	12/07/07	Pentagon is closing 20 NORAD early-warning radar sites in northern Alaska because of erosion caused by waves on ice-free waters.	Article
	12/03/07-12/14/07	Thirteenth Session of the Conference of the Parties to the UN Framework Convention on Climate Change , Bali. <ul style="list-style-type: none"> - Closing Statement at the Conference of the Parties; Dr. P.J. Dobriansky, Under Secretary for Democracy and Global Affairs and Head of U.S. Delegation. - Climate Change: A New Threat to Middle East Security, International Alert. 	Policy
		The Geopolitics of Climate Change, Challenges to the International System	Study
Nov	11/21/07	Singapore Declaration on Climate Change, Energy and the Environment , by Southeast Asian Nations. States concerns about climate change and their intended actions.	Statement
	11/11/07	Woodrow Wilson Institute for Scholars, Climate Change, Environmental Degradation, and Conflict Prevention: A Roundtable Discussion to Identify Policy and Programming Options .	Discussion
	11/07/07	Select Committee on Energy Independence and Global Warming hearing on "Oil Shock: Potential for Crisis." Testimony from Carol P. Browner and Admiral Dennis Blair USN (Ret.) .	Hearing

		<i>The Security Implications of Climate Change</i> , Podesta and Ogden, Center for American Progress.	Paper
		<i>Climate Change and National Security, An Agenda for Action</i> , Busby (Council on Foreign Relations)	Study
		A Climate of Conflict, The links between climate change, peace and war, International Alert.	Study
		<i>The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change</i> , CSIS & CNAS.	Study
Oct	10/25/07	<i>Coast Guard Conducting Arctic Domain Awareness</i> , U.S. Department of Homeland Security & Coast Guard.	Press Release
	10/03/07	House of Representatives, Committee on Energy and Commerce: 1 st in series of climate change white papers, <i>Climate Change Legislation Design White Paper Scope of a Cap-and-Trade Program</i> .	Policy
Sep	09/27/07-09/28/07	<i>Major Economies Meeting on Energy Security and Climate Change</i> , DC. - <i>Final Chairman's Summary: First Major Economies Meeting on Energy Security and Climate Change</i> ; White House Council on Environmental Quality. - <i>Fact Sheet: Major Economies Meeting on Energy Security and Climate Change</i> ; Secretary Rice.	Policy
	09/27/07	House Committee on Science and Technology, Subcommittee on Investigations and Oversight, convened <i>hearing on national security implications of climate change</i> to examine current thinking on the nature and magnitude of the threats that global warming may present to national security, and to explore the ways in which climate-related security threats can be predicted, forestalled, mitigated, or remedied. Expected to be the first in a series of hearings that will seek to identify new areas of research, or new emphases in existing areas, that have begun emerging with the recently burgeoning attention to the links between climate change and national security. Witness statements from: <i>General Gordon R. Sullivan, USA Ret.</i> , <i>Mr. R. James Woolsey</i> (attachment), <i>Dr. Kent H. Butts</i> , <i>Dr. Alexander Lennon</i> , <i>Dr. Andrew Price-Smith</i> .	Hearing
	09/24/07	<i>UN Climate Change Summit</i> aimed at securing political commitment and building momentum for the UN Climate Change Conference in Bali where negotiations about a new international climate agreement should start.	Policy
	09/14/07	<i>Northwest Passage open</i> for the first time since satellite measurements began.	Article
	09/11/07	UK Ministry of Defense funds 5-year <i>Integrated Climate Programme</i> at the Met Office, Hadley Center, to identify regions of the world where global warming could spark conflict and security threats.	Initiative
Aug		<i>Russian submarines placed a Russian flag under the North Pole</i> .	Policy
		Canada announces Arctic base for army training center and deep water port, following last month's plans for six to eight new navy patrol ships to safeguard the Northwest Passage sea route.	
Jul		Issue of <i>Political Geography</i> on climate change and security, see: <i>Nordås and Gleditch</i> , <i>Hendrix and Glaser</i> , <i>Barnett and Adger</i> , <i>Raleigh and Urdal</i> , <i>Meier et al.</i> , <i>Reuveny</i> .	Papers
	07/10/07-07/12/07	<i>Impact of an Ice-Diminishing Arctic on Naval & Maritime Operations</i> , workshop sponsored by the National Ice Center and the U.S. Arctic Research Commission.	Symposium
		Australian Strategic Policy Institute, special report <i>A change in climate for the Australian Defence Force</i> .	Study
		<i>Climate Change and Army Sustainability</i> , Army Environmental Policy Institute.	Policy
		<i>Climate Change and Foreign Policy, An exploration of options for greater integration</i> , International Institute for Sustainable Development, Winnipeg, Canada.	Study

Jun	06/07/07	G8 2007 Heiligendamm Summit Declaration on Growth and Responsibility in the World Economy addresses fighting climate change, technology, market mechanisms, reducing emissions by curbing deforestation, adapting to climate change, and biodiversity [pg. 15-21]. Christian Aid, Oxfam, Practical Action, Tearfund report released prior to G8 meeting.	Policy Report
		Chatham House, The Royal Institute of International Affairs, UK, Briefing Paper How climate change is pushing the boundaries of security and foreign policy .	Paper
May	05/31/07	Fact Sheet: A New International Climate Change Framework , White House, DC. The President announced U.S. support for an effort to develop a new post-2012 framework on climate change by end of 2008.	Policy
	05/09/07	Senate. Committee on Foreign Relations, Climate Change: National Security Threats . Hearing. 110th Congress, 1st session. Witnesses include Admiral Joseph W. Prueher, General Charles F. Wald, and Vice Admiral Richard H. Truly.	Hearing
Apr	4/19/07	Introduction in Congress of S. 1018/H.R. 1961, Global Climate Change Security Oversight Act , requires the DNI to prepare a National Intelligence Estimation on the anticipated geopolitical effects of global climate change and the implications of such effects on U.S. national security, among other requirements; the SecDef to report on military impacts; the Secretary of State to report the potential for large migration flows and diplomatic opportunities and challenges; and authorizes the SecDef to research the impacts of global climate change on military operations, doctrine, organization, training, material, logistics, personnel, and facilities, and the actions needed to address those impacts. (Not voted on.)	Proposed Legislation
	04/18/07	Select Committee on Energy Independence and Global Warming hearing on "Geopolitical Implications of Rising Oil Dependence and Global Warming." Testimony from Ambassador Richard Haass , Vice Admiral Dennis McGinn USN (Ret.) , Carl Pope , General Gordon R. Sullivan USA (Ret.) , and James Woolsey .	Hearing
Mar	04/17/07	First UN Security Council debate on global change . A ministerial-level debate on <i>Energy, Security, and Climate</i> had no formal outcome and several representatives expressed concern about Council encroachment on the prerogatives of the General Assembly and Economic and Social Council. Preceding UK concept paper , Wisner Memorandum Climate Change and Human Security . Kaire Mbuende , Namibian representative to the UN, called the developed countries' emissions of greenhouse gases tantamount to 'low intensity biological or chemical warfare.' Beckett, UK foreign secretary, quoted remarks made by President Yoweri Museveni of Uganda that global warming is 'an act of aggression by the rich against the poor.'	Policy Papers Articles
	04/02/07	Supreme Court's Massachusetts v. EPA climate change decision . Court held that (1) Massachusetts had standing to sue, (2) Section 202 of the Clean Air Act authorizes EPA to regulate emissions from new motor vehicles on the basis of their possible climate change impacts, and (3) Section 202 does not authorize EPA to inject policy considerations into its decision whether to so regulate. CRS Report for Congress .	Law Paper
Feb		Provision added to S. 1538: Intelligence Authorization Act for Fiscal Year 2008 requiring DNI to prepare an NIE on "on the anticipated geopolitical effects of global climate change and the implications of such effects on the national security of the United States" and conducted "using the mid-range projections of the fourth assessment report of the [IPCC]."	Legislation
		IPCC Fourth Assessment on Climate Change .	Reports
		National Security and the Threat of Climate Change , CNA & Military Advisory Board.	Study
Mar	03/29/07 - 03/31/07	National Security Implications of Climate Change , Army War College & Triangle Research Institute for Security Studies.	Colloquium
Feb	02/08/07	U.S. House of Representatives, Committee on Science and Technology hearing on The State of Climate Change Science 2007 .	Hearing
		AUSA Torchbearer National Security Report, Sustaining the Mission, Preserving the Environment, Security the Future .	Report

Jan	01/24/07	Climate Change – The Global Security Impact , hosted by the Royal United Services Institute, UK.	Conference
		The UK's Ministry of Defence (MOD), Development, Concepts and Doctrine Centre (DCDC) reports in Strategic Trends that during the next 30 years human activity will be dominated and affected by 3 pervasive issues: Climate change, Globalization and Global inequality.	Report
Pre-2007		Activity / Event	Type
2006		Heating up the planet: Climate Change and Security , Lowry Institute, Australia. (June)	Study
		Congressional Committee on Government Reform, Subcommittee on National Security, Emerging Threats, and International Relations hearing on Energy as a Weapon: Implications for U.S. Security. Testimony from Gleick, The Implications of Global Climate Changes for International Security . (May)	Hearing
2005		International Workshop on Human Security and Climate Change hosted by Global Environmental Change and Human Security organization in Norway. Includes Who Cares about the Weather? Climate Change and U.S. National Security , by Busby. (June)	Workshop
2004		NIC for Economics and Global Issues hosted a conference entitled Climate Change and Its Implications Through 2020 . This conference was part of the Global Trends 2020 program. (June)	Conference
2003		The Implications of Global Climate Change for International Security, hosted by Sandia National Laboratories, conclusions documented in Global Climate Change and International Security . (November)	Workshop
		An Abrupt Climate Change Scenario and Its Implications for United States National Security , study by Schwartz and Randall, sponsored by the Pentagon Office of Net Assessments. (October)	Study
		Hearing before U.S. Senate Committee on Commerce, Science and Transportation Committee on Abrupt Climate Change. Testimony from R. Alley and T.E. Graedel . (May)	Hearing
2002		Climate Change, Environmental Stress and Conflict , by H.G. Brauch for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Berlin. (November)	Study
		Climate Change and Conflict, Can climate change impacts increase conflict potentials? What is the relevance of this issue for the International Process on Climate Change , report of the Special Event at the 16 th Meeting on the Subsidiary Bodies to the UNFCCC, Bonn, 10 June 2002. Background paper Climate Change and Conflict Prevention .	Meeting
			Paper
2001		Security and Climate Change , report by Barnett, a Visiting Fellow at Tyndall Centre for Climate Change Research. (October)	Paper
		Naval Operations in an Ice Free Arctic hosted by the Oceanographer of the Navy, Office of Naval Research, Arctic Research Commission, and the Naval Ice Center. (April)	Symposium
1999		Security Implications of a Worst-case Scenario of Climate Change in the South-west Pacific , study by Edwards.	Study

Appendix B: Recommendations for DoD – Response to Climate Change Amplified Disasters⁵⁰

B.1. DoD in Steady State Operations

The DoD has a number of installations scattered across the U.S. and its territories, as well as in other nations. These fixed installations and the troops and equipment that conduct steady state operations and activities⁵¹ such as training and maintaining readiness contribute to climate degradation. DoD has several ongoing efforts to determine how its forces are used during steady state to ensure the overall force is properly sized and stationed to accomplish national security objectives when contingencies occur; one part of the climate change calculation. DoD should next determine how much its baseline steady state operations contribute to climate change regionally and globally, especially through carbon-based fuel consumption and emissions.

The Strategic Environmental Research and Development Program⁵² (SERDP) is the DoD environmental science and technology program. If SERDP has not established such a baseline, it should. Once the baseline contributors to climate change have been established, DoD then can investigate how reductions can be made.

- **Recommended Action 1:** SERDP should establish the baseline factors and extent of DoD's contribution to climate change caused by its steady state operations and activities.
- **Recommended Action 2:** SERDP should conduct research into how these factors can be reduced while maintaining force readiness.

B.2. DoD in Contingency Operations

The DoD is also called upon to conduct contingency operations across the globe. These contingencies range from providing humanitarian assistance and disaster relief (HA/DR) to waging combat operations. The purpose of combat is to conclude the action successfully, and one should not be concerned about climate change in these contingencies. However, there are a number of climate change factors that must be considered in lower end HA/DR contingencies, which are becoming more frequent and increasingly greater in scale.

a. Enhancing DoD's Response to Disasters

As your paper highlights, water is likely to be the cause of many future disasters, either because there is too much (flooding) or too little (draught). In either case, when civilian authorities call upon DoD resources to assist in these contingencies (the Federal Emergency Management Agency for domestic and the Office of Foreign Disaster Assistance for foreign), the force must be prepared to deliver the needed response. We

⁵⁰ Appendix B provided by Mr. Mart Lidy

⁵¹ Steady State Operations and Activities – Shaping activities (including Phase 0 elements of contingency plans) designed to promote acceptable international behavior by potential adversaries and sustain peace and stability under conditions that promote U.S. national interests, or set the conditions for military success if a contingency cannot be prevented. (Source: (U) Guidance for the Employment of the Force (GEF), March 2008) Note: They also include maintenance of force readiness to respond to future tasking.

⁵² SERDP is planned and executed in full partnership with the Department of Energy and the Environmental Protection Agency, with participation by numerous other federal and non-federal organizations. To address the highest priority issues confronting the Army, Navy, Air Force, and Marines, SERDP focuses on cross-service requirements and pursues high-risk/high-payoff solutions to the Department's most intractable environmental problems. The development and application of innovative environmental technologies support the long-term sustainability of DoD's training and testing ranges as well as significantly reduce current and future environmental liabilities. See: www.serdp.org/

have examined DoD's response to exercises⁵³ and actual contingencies⁵⁴ and found them needing improvement. Recent discussions with Under Secretary of Defense for Policy, Office of Partnership Strategy and Stability Operations confirm that these concerns still exist.

Unfortunately, HA/DR is not high on the list of training objectives for the forces. One option that might provide the forces with subject matter expertise is to appoint an "HA/DR advisor" in every active and reserve component battalion headquarters and higher echelon organizations through combatant commands. These designated personnel would then be required to undergo specific online training⁵⁵ to understand HA/DR principles, authorities, and community capabilities (both domestic through the National Response Framework and foreign through the draft Federal Foreign Disaster Response Plan) and receive knowledge certification. This option would provide commanders with an advisor with subject matter expertise who can facilitate connecting the military organization to the more formal network of responding organizations.

- **Recommended Action 3:** The Chairman, Joint Chiefs of Staff should require all battalion and higher echelon headquarters through combatant commands to designate an officer as the commander's HA/DR advisor, and require completion of an established online training program to certify the officer.

b. Integrating DoD into the Response Community

The United Nations Military Civil Defense Assets (MCDA) process⁵⁶ was established to coordinate the response of the international community. The Office of the Secretary of Defense and the Joint Staff were instrumental in developing the service modules with the UN staff after the debacle in Rwanda, but the modules have not integrated into DoD's planning for disaster response. The types and numbers of modules are listed in Table B-1.

Table B-1. Major Sectors of Military and Civil Defense Assets

Sectors	# Of Modules	Sectors	# Of Modules
Communications	3	Multi-Role Logistics	5
Coordination Secretariat	5	NBC	7
Electricity	1	Sanitation	3
Engineering	5	Search and Rescue	5
Explosive Ordnance Disposal	3	Transport/Air	4
Food and Catering	1	Transport/Rail	3
Items for Disaster Relief	6	Transport/Sea/Inland Water	1
Medical Support	2	Water Supply	7

Source: MCDA Register

The DoD has a number of capabilities that could be employed as service modules during a disaster, but there is no database that provides this linkage to assist planners during HA/DR contingencies.

⁵³ See: IDA Document D-2638 *DoD Training for Smaller Scale Contingencies: Enhancing Pre-deployment Linkages with Civilian Agencies*, August 2001.

⁵⁴ See: IDA Paper P-3560 *Effectiveness of DoD Humanitarian Relief Efforts in Response to Hurricanes Georges and Mitch*, March 2001.

⁵⁵ The training could be based on material found in D-2963 *Worldwide Humanitarian Assistance Logistics System (WHALS) Handbook*, March 2004.

⁵⁶ See: <http://ocha.unog.ch/cr/register.asp?MenuID=1&MenuEntryID=2&SearchTypeID=1>.

- **Recommended Action 4:** The Joint Staff/J4, in coordination with Joint Forces Command (JFCOM)/J7, should integrate the UN service modules into DoD planning for HA/DR contingencies and link DoD resources to UN service modules to assist military planners.

c. The Water Sector

Because potable water, which is critical to life, will become an increasingly scarce commodity during disasters as climate change continues, DoD will need to take this sector into account when planning its responses. The issues concern both improving its capacity to provide affected populations with water and reducing the water consumption of its forces when deployed to the affected area.

To illustrate the scale of the potential need, the minimum water requirements for a population of **20,000** persons has been calculated based on the Sphere Project⁵⁷ minimum standards and they are summarized in Table B-2. The illustrative calculations are based on applying the UN High Commissioner for Refugees (UNHCR) planning factors⁵⁸ to the assumed number of facilities and persons listed in the table. In this case, most families are assumed to feed themselves and only 2,000 persons will use the feeding center 3 times each day, the health center will process 1,000 patients per day, 10,000 pupils will attend the 4 schools, 2 mosques will each accommodate 10,000 worshipers per day, and 10 administrative offices will operate at the site with 10 cubicles per office.

Table B-2. Minimum Standards for Water – Humans

Need	Number of Facilities /Persons	Metric	Requirement
Minimum Survival	20,000	7 liters/person/day increasing to 20 liters as soon as possible	140,000 liters/day increasing to 400,000 liters/day
Minimum Maintenance	20,000	15-20 liters/person/day	300,000 liters/day
Feeding Center	1/6,000	20-30 liters/person/day	120,000 liters/day
Health Center	1/1,000	40-60 liters/person/day	40,000 liters/day
Schools	4/10,000	3 liters/pupil/day	30,000 liters/day
Mosques	2/20,000	2 to 5 liters/person/day	40,000 liters/day
Hand washing at communal latrines	20,000	1 to 2 liters/person/day	20,000 liters/day
Offices	100 cubicles	2 to 8 liters/cubicle/day	200 liters/day
Water Storage: Large quantity of reasonably safe water preferable to small amount of pure water	2 days of supply	The maximum distance from any shelter to the nearest water point is 500 meters	1,380,400 liters increasing to 1,900,400 liters

Source: *The Sphere Project: Humanitarian Charter and Minimum Standards in Disaster Response*, 2004 is available on line at: http://www.spheredproject.org/handbook_index.htm

The daily water requirements range from a minimum “survival” consumption of 690,200 to a more “livable” consumption of 950,200 liters/day. In addition, it is assumed that the local water storage facilities will hold 2 days of the site’s requirements to ensure a constant supply remains available.

⁵⁷ The Sphere Project was launched in 1997 by a group of humanitarian NGOs and the Red Cross and Red Crescent movement, who framed a Humanitarian Charter and identified Minimum Standards to be attained in disaster assistance, in each of five key sectors (water supply and sanitation, nutrition, food aid, shelter, and health services). This process led to the publication of the first Sphere handbook in 2000, and serves as an agreed international standard.

⁵⁸ UNHCR Handbook for Emergencies available on line at: www.unhcr.org/refworld/pdfid/46a9e29a2.pdf.

The MCDA has identified three levels of water treatment and purification in its “service modules” for the water sector. These capabilities, when applied to the 20,000-person requirement calculated earlier, identify the number of units that each package will need to meet the daily water purification requirements of the temporary camp and are shown in Table B-3. While DoD will be only one of the many responders to a large-scale disaster, usually determined by the UN Inter Agency Standing Committee as involving more than 250,000 victims, the number of ROWPUs for only 20,000 victims – 14 to 95 depending on capacity – is a significant number.

The Army and Marine Corps tactical units are structured to meet their own water needs, not those of an affected population. Both are fielding a new mobile, tactical water purification system⁵⁹ (TWPS) that is designed for purifying a broad range of water sources to meet water requirements of the tactical forces within a division support area. During an HA/DR contingency, specialized DoD units with well-drilling

Table B-3. MCDA Service Modules – Water Treatment and Purification

Package	Capability	Units
Water Treatment/ Purification 1	Operate water purification equipment to provide up to 10,000 liters of potable water/day	69 to 95
Water Treatment/ Purification 2	Operate water purification equipment to provide from 10,000 – 50,000 liters (calculated at 30,000 liters) of potable water/day	23 to 32
Water Treatment/ Purification 3	Operate water purification equipment to provide 50,000 liters and more of potable water/day	14 to 19

capabilities and water testing and purification capabilities will need to be added to the deploying force to provide water support to the affected population. Furthermore, if the Joint Task Force does not include the division support elements with the TWPS, then the specialized units also must provide water for the tactical forces.

Commercially available Reverse Osmosis Water Purification Units (ROWPUs) produce from 5,000 liters/day to more than 500,000 liters/day, but the most common sizes produce about 2,000 to 10,000 liters/day. During a normal 24-hour period, a ROWPU (including the TWPS⁶⁰) will typically require a 4-hour maintenance window to check systems, pumps, filter elements, and the engine generator.

The discussion to this point assumes a source of water can be found in the affected area. If, on the other hand, if water is not readily available in the affected area, DoD may be called upon to transport and distribute large volumes of water from nearby locations. Military ships have capabilities to produce fresh water to support crews and some of this capacity might be used to meet the requirement if ships are available. The ships may also serve as an emergency power source, but will need to connect to local power grids. DoD does not have a reference file that identifies for HA/DR planners the water and electric power capabilities of its ships. Such information would aid planners during future disasters.

- **Recommended Action 5:** The Department of Navy should develop an online database providing the capabilities of its ships to produce fresh water and generate electrical power to assist HA/DR planners.

d. Improving Readiness of HA/DR Joint Task Forces

There are a number of units, retained by Military Departments to perform duties assigned under the U.S.

⁵⁹ The TWPS uses state-of-the-art reverse osmosis technology to produce 1,500 gallons per hour (GPH) (~ 5,680 liters/hour) of potable water from any source, including salt water and nuclear, biological, and chemical contaminated water. This system will replace older 600-GPH (~2,270 liters/hour) reverse osmosis water purification units on a one-for-two basis. The TWPS includes a pre-treatment system, chemical injection, high-pressure pump, ROWPUs, control panel, valves, piping, cold weather protection, wastewater collection, five 3,000-gallon onion tanks, and ocean intake system. It also includes distribution equipment to fill canteens or 5-gallon water cans. The Army's configuration is mounted on a load handling system compatible flat rack, while the Marine Corps version is skid mounted, and truck, train, marine vessel, or fixed-wing aircraft can transport both. The system is set up by three people and operated by one.

⁶⁰ Assuming a duty cycle of 16 hours per day, the TWPS could produce about 90,900 liters of water per day.

Code, that have unique capabilities sought during HA/DR operations. These units could potentially benefit U.S. military units assigned HA/DR missions, host nation personnel requiring training in such specialized disciplines, and/or disaster victims themselves. Examples include the Army Special Medical Augmentation Teams and Combat Stress Control Detachment, U.S. Marine Corps Shock Trauma Platoons and Marine Expeditionary Force Liaison Elements, and Navy Special Psychological Rapid Intervention Teams. Currently, these highly specialized units and their potentially valuable contributions during HA/DR operations are not widely known at the staffs of geographic combatant commands.

- **Recommended Action 6:** The Joint Staff/J4, in conjunction with JFCOM/J7, should ensure that all units retained by Military Departments, but with specialized skills relevant to HA/DR operations, are included in a database⁶¹ supporting HA/DR planners, along with a full description of the unit's capabilities and specialized requirements.

⁶¹ JFCOM inherited from Atlantic Command the Joint Electronic Battlebook (JEB), which was linked to existing Military Department databases and contained invaluable unit and resource information to support HA/DR planners. The JEB is no longer in use, but I have found nothing that replaces it.

REPORT DOCUMENTATION PAGE				<i>Form Approved OMB No. 0704-0188</i>			
<p>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>							
1. REPORT DATE (DD-MM-YY)	2. REPORT TYPE		3. DATES COVERED (From – To)				
July 2009	Study						
4. TITLE AND SUBTITLE			5a. CONTRACT NUMBER DASW01-04-C-0003				
Climate Change Effects: Issues for International and US National Security			5b. GRANT NUMBER				
			5c. PROGRAM ELEMENT NUMBERS				
6. AUTHOR(S)			5d. PROJECT NUMBER				
Christine Youngblut			5e. TASK NUMBER IDA Central Research Program C2222				
			5f. WORK UNIT NUMBER				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESSES			8. PERFORMING ORGANIZATION REPORT NUMBER IDA Document D-3906				
Institute for Defense Analyses 4850 Mark Center Drive Alexandria, VA 22311-1882							
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR'S / MONITOR'S ACRONYM IDA				
Institute for Defense Analyses 4850 Mark Center Drive Alexandria, VA 22311-1882			11. SPONSOR'S / MONITOR'S REPORT NUMBER(S) IDA Document D-3906				
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; unlimited distribution: 29 January 2010.							
13. SUPPLEMENTARY NOTES							
14. ABSTRACT The U.S. is on the threshold of major changes in how it conducts climate change science research. These changes are being driven by several imperatives. One driving force is the growing recognition of the role that societal and ecological processes play in climate change. Another is the need to better support stakeholders who require climate-related information for the development of mitigation policy and adaptation activities. Wide expectations that the new administration will give new impetus to U.S. climate change research, along with increased Congressional interest also play a role. Finally, a new consensus that climate change is progressing much more rapidly than projected just two years ago adds a sense of urgency to these topics. This paper presents a high level picture of this state of events and the key issues that have arisen. It is one in a series of papers looking at climate change issues. The purpose of this series of papers is to raise awareness of the full scope of climate-related concerns. By identifying the key issues, each paper identifies potential opportunities for strengthening the U.S. response to climate change.							
15. SUBJECT TERMS Climate Change; Security Implications.							
16. SECURITY CLASSIFICATION OF: Unclassified		17. LIMITATION OF ABSTRACT Unlimited	18. NUMBER OF PAGES 61	19a. NAME OF RESPONSIBLE PERSON Dr. Christine Youngblut			
a. REPORT Unclassified				b. ABSTRACT Unclassified		c. THIS PAGE Unclassified	